

# **Public Works and Government Services Canada**

## **Edmonton Maximum Security Institution Pumphouse - Flowmeter and Diesel Storage Tank Replacement**

**PWGSC Ref.: R.069549.001**

### **FOR TENDER**

#### **TECHNICAL SPECIFICATIONS Mechanical/Electrical**

July 17, 2014

O/Ref.: 005-P-0005244-100-05-GN-S-0002-00

# Public Works and Government Services Canada

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PWGSC Ref.: R.069549.001

### Technical Specifications Mechanical/Electrical

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RECORD OF REVISIONS AND ISSUES		
REVISION #	DATE	DESCRIPTION OF THE MODIFICATION AND/OR THE ISSUE
00	2014-07-17	For Tender "This document shall not be used for construction purposes"
0B	2014-05-29	Preliminary 90% "This document shall not be used for tender or for construction purposes"
0A	2014-05-16	Preliminary 50% "This document shall not be used for tender or for construction purposes"

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26 28 13.01	E	Fuses - Low Voltage	2	00
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33 56 13	Pb	Aboveground Fuel Storage Tanks	10	00

**Important Note:** This list of sections is used to enumerate required works, without limitation, and to attribute works to contractors according to the symbols explained hereinafter, and it is considered an integral part of the present specification.

All : Applicable section to all works  
 E : Applicable section to electrical works  
 MB : Applicable section to mechanical works  
 Pb : Applicable section to plumbing/heating works  
 PI : Applicable section to fire suppression  
 R : Applicable section to automatic regulation works  
 V : Applicable section to ventilation/air conditioning works

**END OF SECTION**

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## **LIST OF DRAWINGS**

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**MECHANICAL**

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H01	Legend, Drawing List And Controls Diagram	00
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<b>Drawing No.</b>	<b>Title</b>	<b>Rev.</b>
E01	Electricity Pumphouse New Layout	00
E02	Electricity Pumphouse Demolition	00

**END OF SECTION**

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**Division 01 / General Requirements**

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## **PART 1 - GENERAL**

### **1.1 RELATED SECTIONS**

- .1 Sections of Division 01 - General Requirements.
- .2 Sections of Division 22 - Plumbing.
- .3 Sections of Division 23 - Mechanical.
- .4 Sections of Division 25 - Integrated Automation.
- .5 Sections of Division 26 - Electrical.

### **1.2 WORK COVERED BY CONTRACT DOCUMENTS**

- .1 Work of this Contract comprises replacement of the flowmeter and the diesel storage tanks at EMSI Pumphouse. Work include:
    - .1 Mechanical:
      - .1 Supply and install a new flowmeter;
      - .2 Supply and install a new diesel pump and two new diesel tanks;
      - .3 Equipment connections.
    - .2 Integrated Automation:
      - .1 Flowmeter and related equipment controls;
      - .2 Diesel pump and related equipment controls.
      - .3 Plots programming at the control station.
    - .3 Electrical:
      - .1 Connection of the new equipments;
      - .2 Ground.
    - .4 Demolition as indicated;
    - .5 Commissioning;
    - .6 Training of the staff and site maintenance.
-

- .2 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 heating, ventilation 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.

### 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 7:00 a.m. to 4:00 p.m.
  - .2 Departmental Representative must be aware 72 hours prior any works requiring service interruption affecting users.
- .2 Limit use of premises for Work, to allow:
  - .1 Owner occupancy.
  - .2 Work by other contractors.
- .3 Contractor may install for his own use a trailer with a maximum length of 20 feet.
- .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.

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#### **1.4 OWNER OCCUPANCY**

- .1 Owner will occupy premises during entire construction period for execution of normal operations.
- .2 Co-operate with Owner in scheduling operations to minimize conflict and to facilitate Owner usage.

#### **1.5 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 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.

#### **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 48 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.
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- .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**

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## **PART 1 - GENERAL**

### **1.1 USE OF SITE AND FACILITIES**

- .1 Execute Work with least possible interference or disturbance to normal use of premises. Make arrangements with Departmental Representative to facilitate Work as stated.
- .2 Maintain existing services to building and provide for personnel and vehicle access.
- .3 Where security is reduced by Work provide temporary means to maintain security.
- .4 Departmental Representative will assign sanitary facilities for use by Contractor's personnel. Keep facilities clean.
- .5 Closures: Protect Work temporarily until permanent enclosures are completed.

### **1.2 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 48 hours of notice for necessary interruption of mechanical service throughout course of Work. Keep duration of interruptions minimum. Carry out interruptions after normal working hours of occupants, preferably on weekends.

### **1.3 SPECIAL REQUIREMENTS**

- .1 Submit schedule in advance to Departmental Representative for review and approval.
- .2 Ensure Contractor's personnel employed on site become familiar with and obey regulations, including safety, fire, and security regulations.
- .3 Keep within limits of Work and avenues of ingress and egress.
- .4 Contractor will have to shut down the cold water supply to the entire establishment in order to install a shut off valve on main piping to by-pass supply pumps with City water. This interruption will have to be minimized and Contractor shall take measures to prefabricate all of the fittings and transition for the installation of the new water meter beforehand.

### **1.4 BUILDING SMOKING ENVIRONMENT**

- .1 Comply with smoking restrictions. Smoking is not permitted.
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**PART 2 - PRODUCTS**

**2.1 NOT USED**

.1 Not Used.

**PART 3 - EXECUTION**

**3.1 NOT USED**

.1 Not Used.

**END OF SECTION**

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## **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 physical 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, 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.
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- .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, AND colour chips. Submit submittals in accordance with Section 01 33 00 - Submittal Procedures.
  - .4 Requirements for temporary facilities, site sign, offices, storage sheds, utilities, and 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, and administrative requirements.
  - .8 AAC provided products.
  - .9 Record drawings in accordance with Section 01 33 00 - Submittal Procedures.
  - .10 Maintenance manuals in accordance with Section 01 78 00 - Closeout Submittals.
  - .11 Take-over procedures, acceptance, and warranties in accordance with Section 01 78 00 - Closeout Submittals.
  - .12 Monthly progress claims, administrative procedures, photographs, and hold backs.
  - .13 Appointment of inspection and testing agencies or firms.
  - .14 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, and Departmental 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, and conflicts.
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- .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**

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## **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.
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- .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.
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- .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.

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- .2 Submit to Departmental Representative Project Control System for planning, scheduling, monitoring, and reporting of Project progress.
  - .3 Include costs for execution, preparation and reproduction of schedule submittals in bid documents.
  - .4 Submit letter ensuring that schedule has been prepared in co-ordination with major subcontractors.
  - .5 Refer to article "Progress monitoring and reporting" of this specification Section for frequency of Project control system submittals.
  - .6 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 required actions.

## **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.
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## **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 working 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 Samples.
  - .3 Approvals.
  - .4 Procurement.
  - .5 Construction.
  - .6 Installation.
  - .7 Site works.
  - .8 Testing.
  - .9 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.
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- .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 working 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 working 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.
- .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**

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## **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 the Province of Alberta.
  - .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.

**PART 2 - PRODUCTS**

- .1 Not Used.

**PART 3 - EXECUTION**

- .1 Not Used.

**END OF SECTION**

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## **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**

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## **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.
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.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**

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## **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.
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**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.

**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 Parking will be permitted on site provided it does not disrupt performance of Work.
- .2 Provide and maintain adequate access to project site.

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

**PART 2 - PRODUCTS**

- .1 Not Used.

**PART 3 - EXECUTION**

- .1 Not Used.

**END OF SECTION**

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**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**

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## **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.
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### 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 nameplates.

### 1.5 TRANSPORTATION

- .1 Pay costs of transportation of products required in performance of Work.
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## 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.
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- .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 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, 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**

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## **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**

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## **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.

### **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.
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- 
- .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.
  - .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**

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**PART 1 - GENERAL****1.1 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.

**1.2 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 Remove materials from deconstruction as deconstruction/disassembly Work progresses.

**1.3 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.

#### **1.4 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 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.

**END OF SECTION**

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## **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 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 Owner's personnel.
    - .6 Commissioning of mechanical systems: Completed in accordance with 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**

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## **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.
-

- .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 Address and telephone number of Departmental Representative 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 00 - Commissioning - Mechanical and Electrical Installation.

## 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, and 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 Panelboard 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, 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.
-

- 
- .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 4-month and 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, transformers, and commissioned systems.
    - .3 Provide list for each warranted equipment, item and feature of construction or system indicating:
      - .1 Name of item.
      - .2 Model and serial numbers.
      - .3 Location where installed.
-

- .4 Name and phone numbers of manufacturers or suppliers.
  - .5 Names, addresses, and telephone numbers of sources of spare parts.
  - .6 Warranties and terms of warranty: Include one-year overall warranty of construction. Indicate items that have extended warranties and show separate warranty expiration dates.
  - .7 Cross-reference to warranty certificates as applicable.
  - .8 Starting point and duration of warranty period.
  - .9 Summary of maintenance procedures required to continue warranty in force.
  - .10 Cross-Reference to specific pertinent Operation and Maintenance manuals.
  - .11 Organization, names and phone numbers of persons to call for warranty service.
  - .12 Typical response time and repair time expected for various warranted equipment.
- .4 Contractor's plans for attendance at 4-month and 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**

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**PART 1 - GENERAL****1.1 ACRONYMS**

- .1 AFD - Alternate Forms of Delivery, Service Provider.
- .2 Cx - Commissioning.
- .3 EMCS - Energy Monitoring and Control Systems.
- .4 O&M - Operation and Maintenance.
- .5 PI - Product Information.
- .6 PV - Performance Verification.
- .7 TAB - Testing, Adjusting and Balancing.

**1.2 GENERAL**

- .1 Cx is a planned program of tests, procedures, and checks carried out systematically on systems and integrated systems of the finished Project. Cx is performed after systems and integrated systems are completely installed, functional and Contractor's Performance Verification responsibilities have been completed and approved. Objectives:
  - .1 Verify installed equipment, systems, and integrated systems operate in accordance with Contract Documents and design criteria and intent.
  - .2 Ensure appropriate documentation is compiled into the O&M manual.
  - .3 Effectively train O&M staff.
- .2 Contractor assists in Cx process, operating equipment and systems, troubleshooting, and making adjustments as required.
  - .1 Systems to be operated at full capacity under various modes to determine if they are functioning correctly and consistently at peak efficiency. Systems to be interactive with each other as intended in accordance with Contract Documents and design criteria.
  - .2 During these checks, adjustments to be made to enhance performance to meet environmental or user requirements.
- .3 Design Criteria: As per Client's requirements or determined by designer. To meet Project functional and operational requirements.

- .4 AFD managed projects the term Departmental Representative in Cx specifications to be interpreted as AFD Service Provider.

### **1.3 COMMISSIONING OVERVIEW**

- .1 Cx to be a line item of Contractor's cost breakdown.
- .2 Cx activities supplement field quality and testing procedures described in relevant technical sections.
- .3 Cx is conducted in concert with activities performed during stage of project delivery. Cx identifies issues in Planning and Design stages which are addressed during Construction and Cx stages, to ensure the built facility is constructed and proven to operate satisfactorily under weather, environmental, and occupancy conditions to meet functional and operational requirements. Cx activities includes transfer of critical knowledge to facility operational personnel.
- .4 Departmental Representative will issue Interim Acceptance Certificate when:
  - .1 Completed Cx documentation has been received, reviewed for suitability, and approved by Departmental Representative.
  - .2 Equipment, components, and systems have been commissioned.
  - .3 O&M training has been completed.

### **1.4 NON-CONFORMANCE TO PERFORMANCE VERIFICATION REQUIREMENTS**

- .1 Should equipment, system components, and associated controls be incorrectly installed or malfunction during Cx, correct deficiencies, re-verify equipment and components within the unfunctional system, including related systems as deemed required by Departmental Representative, to ensure effective performance.
- .2 Costs for corrective work, additional tests, inspections, to determine acceptability and proper performance of such items to be borne by Contractor. Above costs to be in form of progress payment reductions or hold-back assessments.

### **1.5 PRE-CX REVIEW**

- .1 Before Construction:
  - .1 Review Contract Documents, confirm by writing to Departmental Representative.
    - .1 Adequacy of provisions for Cx.
    - .2 Aspects of design and installation pertinent to success of Cx.

- .2 During Construction:
  - .1 Co-ordinate provision, location, and installation of provisions for Cx.
- .3 Before Start of Cx:
  - .1 Have completed Cx Plan up-to-date.
  - .2 Ensure installation of related components, equipment, sub-systems, and systems is complete.
  - .3 Fully understand Cx requirements and procedures.
  - .4 Have Cx documentation shelf-ready.
  - .5 Understand completely design criteria and intent and special features.
  - .6 Submit complete start-up documentation to Departmental Representative.
  - .7 Have Cx schedules up-to-date.
  - .8 Ensure systems have been cleaned thoroughly.
  - .9 Complete TAB procedures on systems, submit TAB reports to Departmental Representative for review and approval.
  - .10 Ensure "As-Built" system schematics are available.
- .4 Inform Departmental Representative in writing of discrepancies and deficiencies on finished works.

## **1.6 CONFLICTS**

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

## **1.7 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Submittals: In accordance with Section 01 33 00 - Submittal Procedures.
  - .1 Submit no later than 4 weeks after award of Contract:
    - .1 Name of Contractor's Cx agent.

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

### **1.8 COMMISSIONING DOCUMENTATION**

- .1 Refer to Section 01 91 33 - Commissioning (Cx) Forms: Installation Check Lists and Product Information (PI) / Performance Verification (PV) Forms for requirements and instructions for use.
- .2 Departmental Representative to review and approve Cx documentation.
- .3 Provide completed and approved Cx documentation to Departmental Representative.

### **1.9 COMMISSIONING SCHEDULE**

- .1 Provide adequate time for Cx activities prescribed in technical sections and commissioning sections including:
  - .1 Approval of Cx reports.
  - .2 Verification of reported results.
  - .3 Repairs, retesting, re-commissioning, and re-verification.
  - .4 Training.

### **1.10 COMMISSIONING MEETINGS**

- .1 Convene Cx meetings following project meetings as specified herein.
  - .2 Purpose: To resolve issues, monitor progress, and 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 to call a separate Cx scope meeting to review progress, discuss schedule of equipment start-up activities and prepare for Cx. Issues at meeting to include:
  - .1 Review duties and responsibilities of Contractor and subcontractors, addressing delays and potential problems.
  - .2 Determine the degree of involvement of trades and manufacturer's representatives in the Cx process.
- .5 Thereafter, Cx meetings to be held until project completion and as required during equipment start-up and functional testing period.
- .6 Meeting will be chaired by Departmental Representative, who will record and distribute minutes.
- .7 Ensure subcontractors and relevant manufacturer representatives are present at 60% and subsequent Cx meetings, and as required.

### **1.11 STARTING AND TESTING**

- .1 Contractor assumes liabilities and costs for inspections including disassembly and re-assembly after approval, starting, testing, and adjusting, including supply of testing equipment.

### **1.12 WITNESSING OF STARTING AND TESTING**

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

### **1.13 MANUFACTURER'S INVOLVEMENT**

- .1 Factory Testing: Manufacturer to:
  - .1 Coordinate time and location of testing.
  - .2 Provide testing documentation for approval by Departmental Representative.
  - .3 Arrange for Departmental Representative to witness tests.
  - .4 Obtain written approval of test results and documentation from Departmental Representative before delivery to site.

- 
- .2 Obtain manufacturers installation, start-up, and operations instructions prior to start-up of components, equipment and systems, and review with Departmental Representative.
    - .1 Compare completed installation with manufacturer's published data, record discrepancies, and review with manufacturer.
    - .2 Modify procedures detrimental to equipment performance and review same with manufacturer before start-up.
  - .3 Integrity of Warranties:
    - .1 Use manufacturer's trained start-up personnel where specified elsewhere in other divisions or required to maintain integrity of warranty.
    - .2 Verify with manufacturer that testing as specified will not void warranties.
  - .4 Qualifications of manufacturer's personnel:
    - .1 Experienced in design, installation, and operation of equipment and systems.
    - .2 Ability to interpret test results accurately.
    - .3 To report results in clear, concise, and logical manner.

#### **1.14 PROCEDURES**

- .1 Verify that equipment and systems are complete, clean, and operating in normal and safe manner prior to conducting start-up, testing, and Cx.
  - .2 Conduct start-up and testing in following distinct phases:
    - .1 Included in delivery and installation:
      - .1 Verification of conformity to specification, approved shop drawings, and completion of PI report forms.
      - .2 Visual inspection of quality of installation.
    - .2 Start-up: Follow accepted start-up procedures.
    - .3 Operational testing: Document equipment performance.
    - .4 System PV: Include repetition of tests after correcting deficiencies.
    - .5 Post-substantial performance verification: To include fine-tuning.
-

- .3 Correct deficiencies and obtain approval from Departmental Representative after distinct phases have been completed and before commencing next phase.
- .4 Document requires tests on approved PV forms.
- .5 Failure to follow accepted start-up procedures will result in re-evaluation of equipment by an independent testing agency selected by Departmental Representative. If results reveal that equipment start-up was not in accordance with requirements, and resulted in damage to equipment, implement following:
  - .1 Minor equipment/systems: Implement corrective measures approved by Departmental Representative.
  - .2 Major equipment/systems: If evaluation report concludes that damage is minor, implement corrective measures approved by Departmental Representative.
  - .3 If evaluation report concludes that major damage has occurred, Departmental Representative shall reject equipment.
    - .1 Rejected equipment to be removed from site and replaced with new.
    - .2 Subject new equipment/systems to specified start-up procedures.

### **1.15 START-UP DOCUMENTATION**

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

### **1.16 OPERATION AND MAINTENANCE OF EQUIPMENT AND SYSTEMS**

- .1 After start-up, operate, and maintain equipment and systems as directed by equipment/system manufacturer.

- .2 With assistance of manufacturer develop written maintenance program and submit Departmental Representative for approval before implementation.
- .3 Operate and maintain systems for length of time required for commissioning to be completed.
- .4 After completion of commissioning, operate and maintain systems until issuance of certificate of interim acceptance.

**1.17 TEST RESULTS**

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

**1.18 START OF COMMISSIONING**

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

**1.19 INSTRUMENTS / EQUIPMENT**

- .1 Submit to Departmental Representative for review and approval:
  - .1 Complete list of instruments proposed to be used.
  - .2 Listed data including, serial number, current calibration certificate, calibration date, calibration expiry date, and calibration accuracy.

**1.20 COMMISSIONING PERFORMANCE VERIFICATION**

- .1 Carry out Cx:
  - .1 Under actual operating conditions, over entire operating range, in all modes.
  - .2 On independent systems and interacting systems.
- .2 Cx procedures to be repeatable and reported results are to be verifiable.
- .3 Follow equipment manufacturer's operating instructions.
- .4 EMCS trending to be available as supporting documentation for performance verification.

**1.21 WITNESSING COMMISSIONING**

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

**1.22 AUTHORITIES HAVING JURISDICTION**

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

**1.23 COMMISSIONING CONSTRAINTS**

- .1 Since access into secure or sensitive areas will be very difficult after occupancy, it is necessary to complete Cx of occupancy, weather, and seasonal sensitive equipment and systems in these areas before issuance of the Interim Certificate, using, if necessary, simulated thermal loads.

**1.24 EXTRAPOLATION OF RESULTS**

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

**1.25 EXTENT OF VERIFICATION**

- .1 Elsewhere:
  - .1 Provide manpower and instrumentation to verify up to 50% of reported results, unless specified otherwise in other sections.
- .2 Number and location to be at discretion of Departmental Representative.
- .3 Conduct tests repeated during verification under same conditions as original tests, using same test equipment and instrumentation.
- .4 Review and repeat commissioning of systems if inconsistencies found in more than 20% of reported results.

- .5 Perform additional commissioning until results are acceptable to Departmental Representative.

### **1.26 SUNDRY CHECKS AND ADJUSTMENTS**

- .1 Make adjustments and changes which become apparent as Cx proceeds.
- .2 Perform static and operational checks as applicable and as required.

### **1.27 DEFICIENCIES, FAULTS, DEFECTS**

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

### **1.28 COMPLETION OF COMMISSIONING**

- .1 Upon completion of Cx leave systems in normal operating mode.
- .2 Except for warranty and seasonal verification activities specified in Cx specifications, complete Cx prior to issuance of Interim Certificate of Completion.
- .3 Cx to be considered complete when Contract Cx deliverables have been submitted and accepted by Departmental Representative.

### **1.29 ACTIVITIES UPON COMPLETION OF COMMISSIONING**

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

### **1.30 TRAINING**

- .1 In accordance with Section 01 91 41 - Commissioning (Cx) - Training.

### **1.31 MAINTENANCE MATERIALS, SPARE PARTS, SPECIAL TOOLS**

- .1 Supply, deliver, and document maintenance materials, spare parts, and special tools as specified in Contract.

### **1.32 OCCUPANCY**

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

**1.33 INSTALLED INSTRUMENTATION**

- .1 Use instruments installed under Contract for TAB and PV if:
  - .1 Accuracy complies with these specifications.
  - .2 Calibration certificates have been deposited with Departmental Representative.
- .2 Calibrated EMCS sensors may be used to obtain performance data provided that sensor calibration has been completed and accepted.

**1.34 PERFORMANCE VERIFICATION TOLERANCES**

- .1 Application Tolerances:
  - .1 Specified range of acceptable deviations of measured values from specified values or specified design criteria. Except for special areas, to be within  $\pm 10\%$  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.

**1.35 OWNER'S PERFORMANCE TESTING**

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

**PART 2 - PRODUCTS****2.1 NOT USED**

- .1 Not Used.

**PART 3 - EXECUTION****3.1 NOT USED**

- .1 Not Used.

**END OF SECTION**

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## **PART 1 - GENERAL**

### **1.1 INSTALLATION/START-UP CHECK LISTS**

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

### **1.2 PRODUCT INFORMATION (PI) REPORT FORMS**

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

### **1.3 PERFORMANCE VERIFICATION (PV) FORMS**

- .1 PV forms to be used for checks, running dynamic tests, and adjustments carried out on equipment and systems to ensure correct operation, efficiently, and function independently and interactively with other systems as intended with project requirements.
-

- .2 PV report forms include those developed by Contractor's records measured data and readings taken during functional testing and Performance Verification procedures.
- .3 Prior to PV of integrated system, complete PV forms of related systems and obtain Departmental Representative's approval.

#### 1.4 SAMPLES OF COMMISSIONING FORMS

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

#### 1.5 COMMISSIONING FORMS

- .1 Use Commissioning forms to verify installation and record performance when starting equipment and systems.
- .2 Strategy for Use:
  - .1 Departmental Representative provides Contractor project-specific Commissioning forms with Specification data included.
  - .2 Contractor will provide required shop drawings information and verify correct installation and operation of items indicated on these forms.
  - .3 Confirm operation as per Design Criteria and intent.
  - .4 Identify variances between design and operation and reasons for variances.
  - .5 Verify operation in specified normal and emergency modes and under specified load conditions.
  - .6 Record analytical and substantiating data.
  - .7 Verify reported results.
  - .8 Form to bear signatures of recording technician, reviewed, and signed off by Departmental Representative.

- .9 Submit immediately after tests are performed.
- .10 Reported results in true measured SI unit values.
- .11 Provide Departmental Representative with originals of completed forms.
- .12 Maintain copy on site during start-up, testing, and commissioning period.
- .13 Forms to be both hard copy and electronic format with typed written results.

**PART 2 - PRODUCTS**

**2.1 NOT USED**

- .1 Not Used.

**PART 3 - EXECUTION**

**3.1 NOT USED**

- .1 Not Used.

**END OF SECTION**

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**Section 01 91 33 / Appendices**  
**Commissioned Systems and Commissioning Forms**  
- Diesel Day Tank  
- Flowmeter

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## COMMISSIONED SYSTEMS

ITEMS	SYSTEMS	PRESENCE REQUIRED AT THE START-UP	COMMISSIONING DOCUMENTATION	CX SCHEDULE
HVAC SYSTEMS				
1	Diesel Day Tank	General Contractor, Plumbing, Cx Agent.	Installation Checklist, Cx Report	
2	Flowmeter	General Contractor, Plumbing,, Control, Cx Agent.	Installation Checklist, Cx Report	

PROJECT: R.069549.001	<b>Edmonton Maximum Security Institution Pumphouse - Flowmeter and Diesel Storage Tank Replacement</b>	Form: 1	No.:
		1 of 3	
<b>COMMISSIONING FORM</b>			

<b>DIESEL DAY TANK</b>
------------------------

<b>IDENTIFICATION</b>	Equipment Tag:	Serial Number:
	Location:	
	Model Number:	Contractor:
	Type:	Manufacturer:
	System Description: Safe container for flammable fluids (diesel), used as primary diesel source.	

<input type="checkbox"/> Manufacturer reports	<input type="checkbox"/> Performance included	<input type="checkbox"/> Manuals included
---	---	---

<b>INSTALLATION CHECK LIST</b>			
ITEM	YES	NO	COMMENTS
Cabinet and General Installation			
Emergency Vent Cap			
Fuel Day Tank Control, Alarm, and Status Display			
Fuel Containment			
Connexions Types and Sizes			
Communication with (Building Automation System)			

\*Attach the contractor installation check list.

### FUNCTIONAL TESTING RECORD

FUNCTION / MODE	TEST METHOD: MANUAL, AUTOMATIC, EITHER OR BOTH	REQUIRED SEASONAL TEST Y OR N
Start-up test switch shall test contacts for high, low, critical low, ECM (Energy Control Manager) functional, and containment switch to assure wiring of remote contacts is correct.		
Control of Redundant Pump Operation		
Signal from an Electrical Analog Float Sensor		
Fuel Level Alarms		
Warning and Shutdown Conditions		

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

PROJECT: R.069549.001	<b>Edmonton Maximum Security Institution Pumphouse - Flowmeter and Diesel Storage Tank Replacement</b>	Form: 1	No.:
		2 of 3	
<b>COMMISSIONING FORM</b>			

<b>DIESEL DAY TANK</b>
------------------------

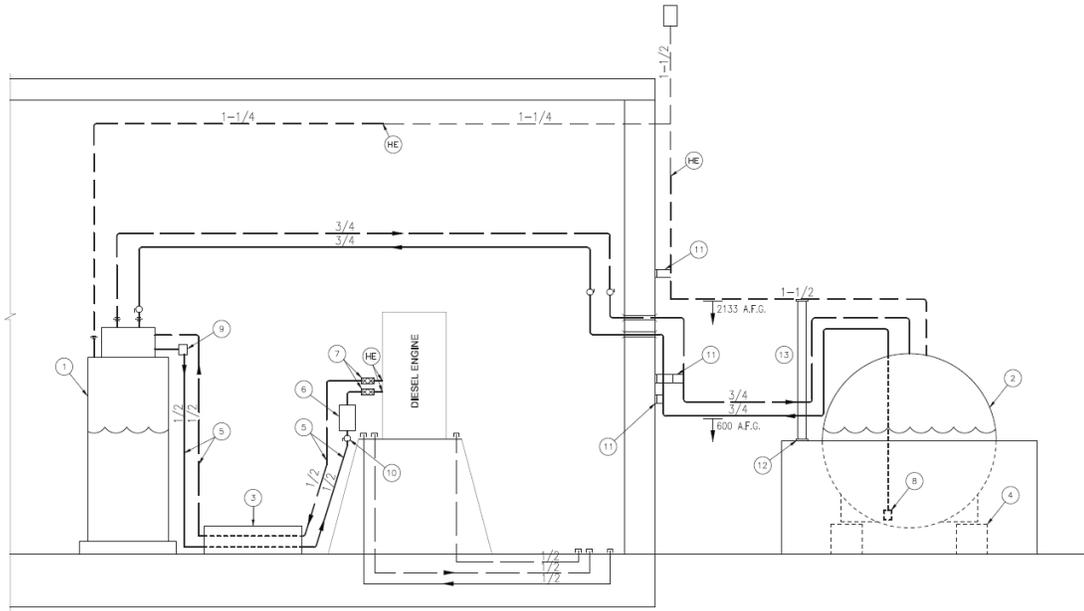
FUNCTION / MODE	TEST METHOD: MANUAL, AUTOMATIC, EITHER OR BOTH	REQUIRED SEASONAL TEST Y OR N
Fuel Level Display: .1 Full - 100% Green LED indicator. .2 95% - Green LED indicator. .3 85% - Green LED indicator. .4 75% - Yellow LED indicator. .5 50% - Yellow LED indicator. .6 25% - Yellow LED indicator. .7 10% - Yellow LED indicator. .8 Empty - 6% - Red LED indicator.		
Alarm Display: .1 High Fuel - 106% or greater of capacity. .2 Low Fuel - 62% of capacity. .3 Critical Low Fuel - 6% of capacity. .4 Fuel within containment. .5 ECM functional - Tank fault.		
Function Display: .1 Power on: This button activates the ECM after the "Off" button has been depressed. On any initial power up condition, after a power outage, the ECM shall be in an on condition. .2 Pump running: For redundant pump operation fuel pump control panel shall indicate Pump A or Pump B running.		
<b>Functional Test:</b> (Diesel control manager) test the sequence of operation (preprogrammed)		

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

PROJECT: R.069549.001	<b>Edmonton Maximum Security Institution Pumphouse - Flowmeter and Diesel Storage Tank Replacement</b>	Form: 1	No.:
		3 of 3	
<b>COMMISSIONING FORM</b>			

**DIESEL DAY TANK**

**Pumphouse Layout (Diesel Fuel Diagram)**



MEMORANDUM (Deficiencies, repair work, sound, and 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: R.069549.001	<b>Edmonton Maximum Security Institution Pumphouse - Flowmeter and Diesel Storage Tank Replacement</b>	Form: 2	No.:
		1 of 2	
<b>COMMISSIONING FORM</b>			

<b>FLOWMETER</b>
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<b>IDENTIFICATION</b>	Equipment Tag:	Serial Number:
	Location:	
	Model Number:	Contractor:
	Type:	Manufacturer:
	System Description:	

<input type="checkbox"/> Manufacturer reports	<input type="checkbox"/> Performance included	<input type="checkbox"/> Manuals included
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INSTALLATION CHECK LIST			
ITEM	YES	NO	COMMENTS
General Installation and Wiring			
Calibration			

\*Attach the contractor installation check list.

### FUNCTIONAL TESTING RECORD

FUNCTION / MODE	TEST METHOD: MANUAL, AUTOMATIC, EITHER OR BOTH	REQUIRED SEASONAL TEST Y OR N
Measure water flow and compare with reading (min. flow to max. flow, 1 pump to 3 pumps). Piping of test flow to ground from pump house.		
Integration with the pump control system and testing of sequences with varying flow.		
<b>Sequence of Operation:</b>		
.1 The meter is provided by Division 23. Connect signal to the control system. Program a point indicating the actual flow. Create a table of hourly, daily, min/max daily, and monthly consumptions for the last 12 months. Record all daily and monthly values in a historical point. .2 Under normal conditions, pump #1 or pump #2 will be the leading pump. The pump lead will be changed weekly on Sunday morning at 4:00 AM. If the lead pump fails, the other pump will start and pump #3 shall be the next pump in sequence. .3 When the system flow exceeds the capacity of lead pump (120 USGPM), the second pump will be started and will run until the flow is below 100 USGPM, at which point only the lead pump will be running. Pump #3 will be started when flow exceeds 240 USGPM and stopped when flow is below 200 USGPM. Future pump #4 will be started when flow exceeds 740 USGPM and stopped when flow is below 700 USGPM. .4 Existing low level switch (LSL102) will shut-off all pumps.		

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

PROJECT: R.069549.001	<b>Edmonton Maximum Security Institution Pumphouse - Flowmeter and Diesel Storage Tank Replacement</b>	Form: 2	No.:
		2 of 2	
<b>COMMISSIONING FORM</b>			

<b>FLOWMETER</b>
------------------

MEMORANDUM (Deficiencies, repair work, sound, and 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 :

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## **PART 1 - GENERAL**

### **1.1 TRAINEES**

- .1 Trainees: Personnel selected for operating and maintaining this facility, including Facility Manager, building operators, and maintenance staff, as required.
- .2 Trainees will be available for training during later stages of construction for purposes of familiarization with systems.

### **1.2 INSTRUCTORS**

- .1 Departmental Representative will provide:
    - .1 Descriptions of systems.
    - .2 Single line flow diagram overlaid with P&ID.
    - .3 Step-by-step sequences of operation for static and dynamic operation c/w design setpoints and limits for normal, abnormal, and emergency situation.
    - .4 Instruction on design philosophy, design criteria, and design intent.
  - .2 Contractor and certified factory-trained manufacturers' personnel: To provide instruction on the following:
    - .1 Control logic specific to static and dynamic operation c/w design setpoints and limits for normal, abnormal, and emergency situation.
    - .2 Start-up, operation, shut-down of equipment, components, and systems.
    - .3 Control features, reasons for, results of, implications on associated systems of, adjustment of setpoints of control and safety devices.
    - .4 Instructions on servicing, maintenance, and adjustment of systems, equipment, and components.
  - .3 Contractor and equipment manufacturer to provide instruction on:
    - .1 Start-up, operation, maintenance, and shut-down of equipment they have certified installation, started up, and carried out PV tests.
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### 1.3 TRAINING OBJECTIVES

- .1 Training to be detailed and duration to ensure:
  - .1 Safe and reliable operation of systems in normal and emergency modes under all conditions.
  - .2 Effective on-going inspection and measurements of system performance.
  - .3 Proper preventive maintenance, diagnosis, and troubleshooting.
  - .4 Ability to update documentation.
  - .5 Ability to operate equipment and systems under emergency conditions until appropriate qualified assistance arrives.

### 1.4 TRAINING MATERIALS

- .1 Instructors to be responsible for content and quality.
- .2 Training materials to include:
  - .1 "As-Built" Contract Documents.
  - .2 Operating and Maintenance Manual.
  - .3 TAB and PV Reports.
- .3 Project Manager, Commissioning Manager, and Facility Manager will review training manuals.

### 1.5 SCHEDULING

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

### 1.6 RESPONSIBILITIES

- .1 Be responsible for:
    - .1 Implementation of training activities.
    - .2 Coordination among instructors.
-

- .3 Quality of training, training materials.
- .2 Departmental Representative will evaluate training and materials.
- .3 Upon completion of training, provide written report, signed by Instructors, witnessed by Departmental Representative.

## **1.7 TRAINING CONTENT**

- .1 Training to include demonstrations by Instructors using the installed equipment and systems.
- .2 Content includes:
  - .1 Review of facility and occupancy profile.
  - .2 Functional requirements.
  - .3 System philosophy, limitations of systems, and emergency procedures.
  - .4 Review of system layout, equipment, components, and controls.
  - .5 Equipment and system start-up, operation, monitoring, servicing, maintenance, and shut-down procedures.
  - .6 System operating sequences, including step-by-step directions for start-up, shut-down, operation of valves, dampers, switches, adjustment of control settings, and emergency procedures.
  - .7 Maintenance and servicing.
  - .8 Troubleshooting diagnosis.
  - .9 Inter-action among systems during integrated operation.
  - .10 Review of O&M documentation.
- .3 Provide specialized training as specified in relevant Technical Sections of the construction specifications.

## **PART 2 - PRODUCTS**

### **2.1 NOT USED**

- .1 Not Used.

**PART 3 - EXECUTION**

**3.1 NOT USED**

.1 Not Used.

**END OF SECTION**

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**Division 22 / Plumbing**

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## **PART 1 - GENERAL**

### **1.1 RELATED SECTIONS**

- .1 Section 01 33 00 - Submittal Procedures.
- .2 Section 01 74 11 - Cleaning.
- .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.
- .6 Section 23 05 05 - Installation of Pipework.

### **1.2 REFERENCES**

- .1 Unless otherwise indicated, all Work must be done in accordance with the latest edition of the National Building Code.
- .2 Furthermore, the works will be done in accordance with any other code or standard having jurisdiction, as per the latest edition, notably including, but not limited to:
  - .1 American National Standards Institute (ANSI)/American Society of Mechanical Engineers International (ASME).
    - .1 ANSI/ASME B16.15 2006, Cast Bronze Threaded Fittings, Classes 125 and 250.
    - .2 ANSI/ASME B16.18 2001, Cast Copper Alloy Solder Joint Pressure Fittings.
    - .3 ANSI/ASME B16.22 2001, Wrought Copper and Copper Alloy Solder Joint Pressure Fittings.
    - .4 ANSI/ASME B16.24 2001, Cast Copper Alloy Pipe Flanges and Flanged Fittings, Classes 150, 300, 400, 600, 900, 1500, and 2500.
  - .2 American Society for Testing and Materials International (ASTM).
    - .1 ASTM A182, Standard Specification for Forged or Rolled Alloy and Stainless Steel Pipe Flanges, Forged Fittings, and Valves and Parts for High-Temperature Service.
    - .2 ASTM A268/A268M, Standard Specification for Seamless and Welded Ferritic and Martensitic Stainless Steel Tubing for General Service.

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- .3 ASTM A269, Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service.
  - .4 ASTM A307, Standard Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.
  - .5 ASTM A312/A312M, Standard Specification for Seamless, Welded and Heavily Cold Worked Austenitic Stainless Steel Pipes.
  - .6 ASTM A403, Standard Specification for Wrought Austenitic Stainless Steel Piping Fittings.
  - .7 ASTM B32, Standard Specification for Solder Metal.
  - .8 ASTM B88M, Standard Specification for Seamless Copper Water Tube (Metric).
  - .9 ASTM F492, Standard Specification for Propylene and Polypropylene (PP) Plastic-Lined Ferrous Metal Pipe and Fittings.
  - .10 ASTM B283/B283M, Standard Specification for Copper and Copper-Alloy Die Forging (Hot-Pressed).
- .3 American National Standards Institute/American Water Works Association (ANSI/AWWA).
    - .1 ANSI/AWWA C111-07, Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.
  - .4 Canadian Standards Association (CSA International).
    - .1 CSA B242-M1980 (R1998), Groove and Shoulder Type Mechanical Pipe Couplings.
  - .5 Manufacturer's Standardization Society of the Valves, and Fittings Industry (MSS).
    - .1 MSS-SP-70-1998, Cast Iron Gate Valves, Flanged and Threaded Ends.
    - .2 MSS-SP-71-1997, Cast Iron Swing Check Valves, Flanged and Threaded Ends.
    - .3 MSS-SP-80-2003, Bronze Gate, Globe, Angle and Check Valves.
  - .6 National Sanitation Foundation (NSF).
    - .1 NSF 61, Drinking Water System Components.
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### 1.3 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 insulation and adhesives, and include product characteristics, performance criteria, physical size, finish, and limitations.
- .3 Closeout Submittals:
  - .1 Provide maintenance data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.

### 1.4 HEALTH AND SAFETY

- .1 Take necessary measures to ensure health and safety on construction site 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.
- .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.

### 1.6 QUALITY ASSURANCE

- .1 All components used in the potable water distribution must follow NSF 61 Standard.
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## **PART 2 - PRODUCTS**

### **2.1 PIPING**

- .1 Domestic cold water within building.
  - .1 NPS 2 ½ and above: Schedule 10, 304L stainless steel according to ASTM and NSF/ANSI-61 Standards.

### **2.2 FITTINGS**

- .1 Stainless Steel:
  - .1 NPS 2 ½ and above: Schedule 10, welded, according to ASTM A403, grade WP-304L, and ANSI B16.9 Standards.
  - .2 Cast stainless steel flanges, Class 150, according to ASTM A182, grade F304L, and ANSI B16.5 Standards.
  - .3 Union: Class 3000, forged stainless steel, according to ASTM A182, grade F304L Standard.

### **2.3 JOINTS**

- .1 Rubber Gaskets (1.6 mm thick): To AWWA C111/A21.11.
- .2 Bolts, Nuts, Hex Head, and Washers: To ASTM A307, Heavy Series.
- .3 Dielectric Connections between Dissimilar Metals: Dielectric fitting, complete with thermoplastic liner.

### **2.4 BUTTERFLY VALVES**

- .1 NPS 2½ and over, flanged:
    - .1 ASME B16.50 face-to-face dimensions.
    - .2 To MSS-SP-67, Class 125/150. Ductile iron body and plated disc, stainless steel stem, EPT liner. Gear operated.
      - .1 Acceptable products: Nibco, FD-5765-0.
-

## 2.5 FLOWMETER

- .1 Approvals:
    - .1 CSA approved.
    - .2 OIML R49 (Organisation internationale de métrologie légale).
  - .2 Performance:
    - .1 Flowmeter with reduced bore to improve flow profile and to keep good accuracy even if pipe layout is shorter than normally specified.
    - .2 Accuracy:  $\pm 0.4\%$ .
  - .3 Characteristics:
    - .1 Electromagnetic.
    - .2 Carbon steel housing.
    - .3 Liner material: Elastomer.
    - .4 Ambient temperature limitation: -20 to 70°C.
    - .5 Stainless steel 316 L electrode.
    - .6 Flanged connections NPS 8, Class 150.
  - .4 Flowmeter Transmitter:
    - .1 Characteristics:
      - .1 Power supply: 100-230 VAC, 60 Hz.
      - .2 4-20 mA with communication and pulse output.
      - .3 Illuminated display.
      - .4 Diagnostic message and error code as per Namur NE107 Standards.
  - .5 Acceptable Products: ABB, Watermaster FER Series.
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## **PART 3 - EXECUTION**

### **3.1 APPLICATION**

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

### **3.2 INSTALLATION**

- .1 Install in accordance with National Building Code, and local authority having jurisdiction.
- .2 Install pipe work in accordance with Section 23 05 05 - Installation of Pipework, supplemented as specified herein.
- .3 Assemble piping using fittings manufactured to ANSI Standards.
- .4 Install piping close to walls and ceilings to reduce overcrowding of space. Group piping and install parallel to walls.
- .5 Connect to fixtures and equipment in accordance with manufacturer's written instructions, unless otherwise indicated.

### **3.3 VALVES**

- .1 Isolate equipment, fixtures, and branches with ball valves.
- .2 Balance recirculation system using lockshield globe valves. Mark settings and record on as-built drawings upon completion.

### **3.4 PRESSURE TESTS**

- .1 Complying with requirements of Section 23 05 93 - Testing, Adjusting, and Balancing for HVAC.
- .2 Test Pressure: Greater than one time maximum system operating pressure or 860 kPa during 2 hours.

### **3.5 PRE-START-UP INSPECTIONS**

- .1 Systems to be complete, prior to flushing, testing, and start-up.
  - .2 Verify that system can be completely drained.
-

**3.6 CLEANING AND DISINFECTION**

- .1 Every pipe segment and equipment must be thoroughly cleaned and disinfected and rinsed before installation.
- .2 Disinfecting Solution: Sodium hypochlorite, complying to ANSI/AWWA B300 Standard.

**3.7 START-UP**

- .1 Provide continuous supervision during start-up.
- .2 Establish circulation and ensure that air is eliminated.
- .3 Rectify start-up deficiencies.

**3.8 PERFORMANCE VERIFICATION**

- .1 Scheduling:
  - .1 Verify system performance after pressure and leakage tests and disinfection are completed, and Certificate of Completion has been issued by authority having jurisdiction.
- .2 Procedures:
  - .1 Verify that flow rate and pressure meet design criterion.
  - .2 Verify compliance with safety and health requirements.
  - .3 Confirm water quality consistent with supply standards, and ensure no residuals remain as result of flushing or cleaning.
- .3 Reports: In accordance with section 01 33 00 - Submittal Procedures.

**3.9 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**

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**Division 23 / Heating, Ventilation and Air Conditioning  
(HVAC)**

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**PART 1 - GENERAL****1.1 RELATED SECTIONS**

- .1 All sections defined in the section list are an integral part of this section.

**1.2 SUBMITTALS**

- .1 Submittals: In accordance with Section 01 33 00 - Submittal Procedures.
- .2 Shop drawings to show:
  - .1 Mounting arrangements.
  - .2 Operating and maintenance clearances.
- .3 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.
- .4 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.
- .5 Closeout Submittals:
  - .1 Provide operation and maintenance data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.
  - .2 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 instructions for systems and component.

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- .5 Description of actions to be taken in event of equipment failure.
  - .6 Valves schedule and flow diagram.
  - .7 Colour coding chart.
  - .3 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.
  - .4 Performance data to include:
    - .1 Equipment manufacturer's performance datasheets with point of operation as left after commissioning is completed.
    - .2 Equipment performance verification test results.
    - .3 Special performance data as specified elsewhere in Contract Documents.
  - .5 Additional data:
    - .1 Prepare and insert into operation and maintenance manual additional data when need for it becomes apparent during specified demonstrations and instructions.
  - .6 Site records:
    - .1 Keep a copy of drawings on Work site. Identify "As-Built" drawings and indicate, as Work goes along, all changes that are made during the execution of the Works to materials, mechanical equipment, control/regulation systems, and to low voltage control wiring.
    - .2 Use different colour permanent ink for each service.
    - .3 Make drawings available for reference purposes and inspection.
  - .7 "As-Built" drawings:
    - .1 Prior to start of Testing, Adjusting and Balancing for HVAC, finalize production of "As-Built" drawings.
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- .2 Identify each drawing in lower right hand corner in letters at least 12 mm (1/2 in.) high as follows: - "AS-BUILT DRAWINGS: THIS DRAWING HAS BEEN REVISED TO SHOW MECHANICAL SYSTEMS AS INSTALLED" (Signature of Contractor) (Date).
- .3 Submit drawings 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.
- .8 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.

### **1.4 MAINTENANCE**

- .1 Furnish spare parts in accordance with Section 01 78 00 - Closeout Submittals:
  - .1 Provide one set of special tools required to service equipment as recommended by manufacturers and in accordance with Section 01 78 00 - Closeout Submittals.
  - .2 Provide one commercial quality grease gun, grease and adapters to suit different types of grease and grease fittings.

### **1.5 DELIVERY, STORAGE, AND HANDLING**

- .1 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 and Disposal.

## **PART 2 - PRODUCTS**

- .1 Not Used.

**PART 3 - EXECUTION****3.1 PAINTING REPAIRS AND RESTORATION**

- .1 Prime and touch-up marred finished paintwork to match original.
- .2 Restore to new condition finishes which have been damaged.

**3.2 CLEANING**

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

**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 Schedule site visits, to review Work, as directed in PART 1 - QUALITY ASSURANCE.

**3.4 DEMONSTRATION**

- .1 Departmental Representative will use equipment and systems for test purposes prior to acceptance. Supply labour, material, and instruments required for testing.
  - .2 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.
  - .3 Use operation and maintenance manual, "As-Built" drawings, and audio visual aids as part of instruction materials.
  - .4 Instruction duration time requirements as specified in each appropriate section.
-

### **3.5 PROTECTION**

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

**END OF SECTION**

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## **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 23 05 00 - Common Work Results for Mechanical.

### **1.2 REFERENCE**

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

### **1.3 SUBMITTALS**

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

### **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, address.
- .3 Construction/Demolition Waste Management and Disposal: 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.
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## **PART 3 - EXECUTION**

### **3.1 APPLICATION**

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

### **3.2 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.

### **3.3 CLEARANCES**

- .1 Provide clearance around systems, equipment and components for observation of operation, inspection, servicing, and maintenance, and as recommended by manufacturer.
- .2 Provide space for disassembly, removal of equipment and components (whichever is greater) without interrupting operation of other system, equipment, and components of network. Fitted out space has to be of dimensions as indicated on drawings or as recommended by manufacturer, the most raised value must be retained.

### **3.4 PIPEWORK INSTALLATION**

- .1 Installed piping as recommended in CSA B139 Standard.
  - .2 Screwed fittings jointed with Teflon tape.
  - .3 Protect openings against entry of foreign material.
  - .4 Install to isolate equipment and allow removal without interrupting operation of other equipment or systems.
  - .5 Assemble piping using fittings manufactured to ANSI Standards.
  - .6 Install exposed piping, equipment, rectangular cleanouts, and similar items parallel or perpendicular to building lines.
  - .7 Install concealed pipework to minimize furring space, to maximize headroom, and to conserve space.
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- .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 or as indicated.
- .11 Ream pipes, remove scale, and other foreign material inside out before assembly. Clean also when Work is completed.
- .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 or vertical upward, unless otherwise indicated.
  - .4 Valves accessible for maintenance without removing adjacent piping.
  - .5 Use gate or ball valves at branch take-offs for isolating purposes, except where specified.

### 3.5 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, stainless steel 304 for floor of cooking and prep areas.
- .3 Construction: Foundation walls and where sleeves extend above finished floors to have annular fins continuously welded on at mid-point.
- .4 Sizes: 6 mm minimum clearance between sleeve and uninsulated pipe or between sleeve and insulation.
- .5 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 Standard.
- .6 Sealing.
  - .1 Foundation walls and below grade floors: Fire retardant, waterproof non-hardening mastic.
  - .2 Elsewhere: Provide space for firestopping. Maintain required 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.

### **3.6 FLUSHING OUT OF PIPING SYSTEMS**

- .1 Before start-up, clean interior of piping systems in accordance with requirements of Section 01 74 11 - Cleaning supplemented, as specified in Division 23.
- .2 Preparatory to acceptance, clean and refurbish equipment and leave in operating condition, including replacement of filters in piping systems.

### **3.7 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 of Division 23.
- .3 Maintain specified test pressure without loss for 4 hours minimum unless specified for longer period of time in relevant of Division 23.
- .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.

### **3.8 EXISTING SYSTEMS**

- .1 Connect 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 this Work.
- .4 Ensure daily clean-up of existing areas.

### **3.9 CLEANING**

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

**END OF SECTION**

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## **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.

### **1.2 REFERENCES**

- .1 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 (ANSI)/American Society of Mechanical Engineers International (ASME).
    - .1 ANSI/ASME B31, ASME Code for Pressure Piping and Power Piping.
      - .1 ANSI/ASME B31.1, Power Piping.
      - .2 ANSI/ASME B31.3, Process Piping Addenda A.
      - .3 ANSI/ASME B31.3, Process Piping Addenda B.
    - .2 ANSI/ASME Boiler and Pressure Vessels Code.
      - .1 Section I: Pressure Boilers.
      - .2 Section V: Non-Destructive Examinations.
      - .3 Section IX: Welding and Brazing Qualifications.
  - .2 American National Standards Institute/American Water Works Association (ANSI/AWWA).
    - .1 ANSI/AWWA C206-03 Field Welding of Steel Water Pipe.
  - .3 American Welding Society (AWS).
    - .1 AWS B3.0, Welding Procedures and Performance Qualifications.
    - .2 AWS C1.1, Recommended Practices for Resistance Welding.

- .3 AWS Z49.1, Safety Welding, Cutting and Allied Process.
- .4 AWS W1, Welding Inspection Handbook.
- .4 Canadian Standards Association (CSA International).
  - .1 CSA W47.2-M1987(R2008), Certification of Companies for Fusion Welding of Aluminum.
  - .2 CSA W48-06, Filler Metals and Allied Materials for Metal Arc Welding.
  - .3 CSA B51-03(R2007), Boiler, Pressure Vessel and Pressure Piping Code.
  - .4 CSA-W117.2-2006, 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.
- .5 Canadian General Standards Board (ONGC/CGSB).
  - .1 CAN/CGSB 48.2, Spot Radiography of Welded Butt Joints in Ferrous Materials.

### **1.3 QUALIFICATIONS OF WELDERS**

- .1 Welding qualifications in accordance with CSA B51 Standard.
- .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 Standard.

### **1.4 QUALIFICATION OF INSPECTORS**

- .1 Inspectors qualified to CSA W178.2 Standard.

### **1.5 WELDING METHOD**

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

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

## **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 Standard, using procedures complying with 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 SPECIAL REQUIREMENTS - STAINLESS STEEL WELDING**

- .1 Special attention should be paid when welding stainless steel in both worksite and workshop. Avoid carbon steel welding or grinding close to stainless steel welding in order to avoid contamination by carbon steel particles.
  - .2 Stainless steel welded joints must fully penetrate pipes.
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- .3 First pass must be performed with GTAW-GAS TUNGSTEN ARC (TIG) method. Provide a minimum of two passes.
- .4 Do not use "Backing Rings" for stainless steel welding of pipe tips.
- .5 Stainless steel welding must be carried out using a noble gas purge method.
- .6 When welding, pipes must be pre-purged and purged at a constant flow.

### 3.4 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.

### 3.5 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 Standard 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.

### 3.6 DEFECTS CAUSING REJECTION

- .1 General :
  - .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.

### 3.7 REPAIR OF WELDS WHICH FAILED TESTS

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

### 3.8 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**

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**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.
- .5 Section 23 05 00 - Common Work Results for Mechanical.

**1.2 REFERENCES**

- .1 Furthermore, the works will be done in accordance with any other code or standard having jurisdiction, as per the latest edition, notably including, but not limited to:
  - .1 American Society for Testing and Materials International (ASTM).
    - .1 ASTM A125-1996(R2001), Specification for Steel Springs, Helical, Heat-Treated.
    - .2 ASTM A307-04, Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.
    - .3 ASTM A563-04a, Specification for Carbon and Alloy Steel Nuts.
  - .2 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.
  - .3 Underwriter's Laboratories of Canada (ULC).
  - .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 Submit shop drawings and product data for following items:
  - .1 Bases, hangers, and supports;
  - .2 Connections to equipment and structure;
  - .3 Structural assemblies.
- .3 Certificates:
  - .1 Submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
- .4 Instructions:
  - .1 Submit manufacturer's installation instructions.
- .5 Closeout Submittals.
  - .1 Provide maintenance data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.

**1.4 DELIVERY, STORAGE, AND HANDLING**

- .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 SYSTEM DESCRIPTION**

- .1 Design Requirements.
  - .1 Construct pipe hanger and support to manufacturer's recommendations using manufacturer's regular production components, parts, and assemblies.
  - .2 Base maximum load ratings on allowable stresses prescribed by MSS SP58 or ASME B31.1 Standard.
  - .3 Design hangers and supports to support piping, air ducts, systems and mechanical equipments under operating conditions allow free expansion and contraction of

supported elements, to prevent excessive stress from being introduced into piping or connected equipments.

- .4 Provide for vertical adjustments after erection and during commissioning. Amount of adjustment in accordance with MSS SP58 Standard.

## **2.2 GENERAL**

- .1 Fabricate hangers, supports, and sway braces in accordance with ANSI B31.1 and MSS SP58 Standards.
- .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.

## **2.3 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 Steel Beam (suspension from lower flange).
  - .1 Piping up to NPS 2: Malleable cast iron "C" flanges, complying with MSS-SP-58 Standard, type 23, ULC and FM approved.
    - .1 Acceptable products: Anvil, Fig. 93.
  - .2 Piping NPS 2½ and greater: Malleable cast iron beam attachments, complying with MSS-SP-69 Standard, type 20, ULC and FM approved.
    - .1 Acceptable products: Anvil, Fig. 218 (with extension piece Fig. 157) or Fig. 228, if 218 is too small.
- .3 Steel Beam (suspension from upper flange).
  - .1 Malleable cast iron "C" flanges, complying with MSS-SP-58 Standard, type 23, ULC, and FM approved.
    - .1 Acceptable products: Anvil, Fig. 93 or 94.

- 
- .2 Retaining stirrup in the upper sill of a beam, assembly made of a steel jaw, a rod-hook with nut, a spring washer and a common washer corresponding to MSS-SP-69 Standard, type 25, and approved by ULC and FM.
    - .1 Acceptable products: Anvil, Fig. 227 for suspension rod of NPS  $\frac{3}{8}$  and NPS  $\frac{1}{2}$ .
  - .4 Steel Joist.
    - .1 Piping up to NPS 2: Steel support plates, with two (2) lock nuts.
      - .1 Acceptable products: Anvil, Fig. 60.
    - .2 Piping NPS 2½ and over: Steel support plates, with two (2) lock nuts, carbon steel weldable attachment and malleable cast iron eyelet bolt.
      - .1 Acceptable products: Anvil - support plate, Fig. 60, weldable attachment, Fig. 66 and malleable cast iron eyelet bolt, Fig. 290.
    - .3 Carbon steel welded attachments with two blocking nuts and in accordance with MSS SP69 Standard, type 22.
      - .1 Acceptable products: Anvil, Fig. 66.
  - .5 Steel Shaped or Angle (bottom flange).
    - .1 Malleable cast iron "C" flanges, complying with MSS-SP-58 Standard, type 23, ULC approved.
      - .1 Acceptable products: Anvil, Fig. 93 or 94.
  - .6 Steel Shaped or Angle (upper flange).
    - .1 Retaining stirrup in the upper sill of a beam, assembly made of a steel jaw, a rod-hook and a common washer, corresponding to MSS-SP-69 Standard, type 25, and approved by ULC and FM.
      - .1 Acceptable products: Anvil, Fig. 227 for suspension rod of NPS  $\frac{3}{8}$  and NPS  $\frac{1}{2}$ .
  - .7 Wood Elements.
    - .1 Ceiling flange made of malleable cast iron.
      - .1 Acceptable products: Anvil, Fig. 128R.
-

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- .8 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 (0.236 in) 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 complying with MSS-SP-69 Standard.
      - .1 Acceptable products: Anvil, Fig. 281.
  - .9 Assemblies made in a shop or on site:
    - .1 Suspension with rollers.
    - .2 Steel supports.
    - .3 Bracing items for earthquake systems: Complying with Section 23 05 48.
  - .10 Threaded Suspension Rods: Complying with 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.
  - .11 Support elements installed directly on the piping:
    - .1 Steel or plastic piping with less than 25 mm of movement: Adjustable stirrups complying with MSS-SP-69 Standard, type 10, 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 stirrups complying with MSS-SP-69 Standard, type 10.
      - .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 Standard, type 43.
  - .1 Acceptable products: Anvil, Fig. 181.
- .4 Steel or plastic piping supported from the underside: Base with rollers complying with MSS-SP-69 Standard, type 44.
  - .1 Acceptable products: Anvil, Fig. 175, 177, and 271.
- .12 "U" Bolts: Made of carbon steel complying with MSS-SP-69 Standard, complete with two (2) nuts complying with ASTM A563 Standard on each end.
  - .1 Galvanized finish for steel piping.
  - .2 Plastic finish for copper, glass, brass, or aluminum piping.

## **2.4 EQUIPMENT SUPPORTS**

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

## **2.5 EQUIPMENT ANCHOR BOLTS AND TEMPLATES**

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

## **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 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.

- .2 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.

### 3.3 SPACING BETWEEN SUPPORTS AND SUSPENSIONS

- .1 Follow the requirements of the Alberta Construction Code for plumbing piping network.
- .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 Install supports at base of vertical piping, at the high point of each floor.
- .5 In addition to the above required supports, install supports and suspensions on the straight lengths of the piping as described in the tables below:

<b>PLUMBING PIPING</b>						
<b>MAXIMUM SPACING FOR HORIZONTAL PIPING, IN METERS</b>						
Ø PIPING (NPS)	Ø ROD mm	STEEL	COPPER	ASBESTOS CEMENT	ABS PVC	CPVC
Up to ½	10	2.1	1.5	---	0.9	0.8
¾	10	2.1	1.5	---	1.0	0.9
1	10	2.1	1.8	---	1.1	1.0
1¼	10	2.1	2.1	2.0	1.2	1.2
1½	10	2.7	2.4	2.0	1.3	1.3
2	10	3.0	2.4	2.0	1.5	1.4
2½	13	3.4	2.7	2.0	---	1.7
3	13	3.6	3.0	2.0	1.9	1.8

<b>DIESEL PIPING</b>			
<b>MAXIMUM SPACING FOR HORIZONTAL PIPING, IN METERS</b>			
Ø PIPING (NPS)	Ø ROD mm	STEEL	COPPER
Up to ½	10	1.8	1.8
¾	10	2.4	2.4
1	10	2.4	2.4
1¼	10	3.0	3.0
1½	10	3.0	3.0

<b>DIESEL PIPING</b>			
<b>MAXIMUM SPACING FOR HORIZONTAL PIPING, IN METERS</b>			
<b>Ø PIPING (NPS)</b>	<b>Ø ROD mm</b>	<b>STEEL</b>	<b>COPPER</b>
2	10	3.0	3.0
2½	13	3.0	3.0
3	13	4.6	4.6
3½	13	4.6	4.6
4	16	4.6	4.6

### **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 Fix support and suspension elements to the frame. Provide and install all additional steel frame parts that are required.
- .5 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 degrees 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 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.

### **3.7 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.

### **3.8 CLEANING**

- .1 Clean in accordance with Section 01 74 11 - Cleaning.
  - .1 Dispose of construction materials surplus, waste, tools, and equipment.

**END OF SECTION**

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**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.

**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.
- .3 National Fire Protection Association (NFPA).
  - .1 NFPA 13-2010, Standard for the Installation of Sprinkler 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, and lists of proposed legends.

**1.4 QUALITY ASSURANCE**

- .1 Quality Assurance Submittals: Submit following in accordance with Section 01 45 00 – Quality Control.

**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 to be raised or recessed.
- .3 Information to include, as appropriate:
  - .1 Equipment: Manufacturer's name, model, size, serial number, and capacity.
  - .2 Motor: Voltage, Hz, phase, power factor, duty, and 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 Standard, 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 Standard.

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 Height: 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 150 °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>		
Safety Valve	Yellow	SAFETY VALVE
Domestic Hot Water	Green	DOM. HOT WTR
Domestic Chilled Water	Green	DOM. CH. WTR
Diesel	Yellow	FUEL

## 2.5 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, and location of tagged item.

**2.6 CONTROLS COMPONENTS IDENTIFICATION**

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

**2.7 LANGUAGE**

- .1 Inscriptions used for system identification must be written in English.

**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 work is done.

**3.3 INSTALLATION**

- .1 Perform work in accordance with CAN/CGSB-24.3 Standard, 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 Stand-offs.
  - .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 Flowmeter;
  - .3 Tanks.

### **3.5 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.

### **3.6 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**

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**PART 1 - GENERAL****1.1 RELATED SECTIONS**

- .1 Division 23 - Mechanical.
- .2 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.
  - .3 Sheet Metal and Air Conditioning Contractors' National Association (SMACNA), HVAC TAB HVAC Systems - Testing, Adjusting and Balancing.
- .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 and standards to satisfaction of authority having jurisdiction.

#### **1.6 CO-ORDINATION**

- .1 Schedule time required for TAB (including repairs and 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, and other construction affecting TAB.
  - .2 Application of weatherstripping, sealing, and caulking.
  - .3 Pressure, leakage, and 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 Hydronics systems:
      - .1 Liquid systems flushed, filled, and 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.

**1.11 APPLICATION TOLERANCES**

- .1 Do TAB to following tolerances of design values:
  - .1 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 Calculation 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, and 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 HYDRONICS SYSTEMS**

- .1 For the needs for this section, the systems hydronic include the system using the following fluid: Diesel.
  - .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 systems, apparatuses, elements, and 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, apparatuses, elements, or control devices and regulation concerned: Static pressure, flow rate, pressure drop, temperature, density, number of revolutions, power, voltage, and 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 changings;
  - .2 At regulators and 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 supply and return of primary and secondary loops (principal drains, principal and secondary drain connections, supply lines of final elements of hydronic systems).

**PART 2 - PRODUCTS**

- .1 Not Used.

**PART 3 - EXECUTION**

- .1 Not Used.

**END OF SECTION**

**PART 1 - GENERAL****1.1 RELATED SECTIONS**

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

**1.2 REFERENCES**

- .1 American National Standard Institute/American Society of Mechanical Engineers (ANSI/ASME).
  - .1 ANSI/ASME B31.1-2010, Power Piping.

**1.3 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, and fluctuations by simulating maximum design conditions and varying.

**PART 2 - PRODUCTS**

- .1 Not Used.

**PART 3 - EXECUTION**

- .1 Not Used.

**END OF SECTION**

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## **PART 1 - GENERAL**

### **1.1 REFERENCES**

- .1 American Society of Mechanical Engineers (ASME).
  - .1 ASME-B16.3-2006, Malleable-Iron Threaded Fittings: Classes 150 and 300.
  - .2 ASME-B16.9-2007, Factory-Made Wrought Steel Buttwelding Fittings.
- .2 ASTM International.
  - .1 ASTM A47/A47M-99(2004), Standard Specification for Ferritic Malleable Iron Castings.
  - .2 ASTM A53/A53M-07, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc Coated, Welded and Seamless.
  - .3 ASTM B61-08, Standard Specification for Steam or Valve Bronze Castings.
  - .4 ASTM B75M-99(2005), Standard Specification for Seamless Copper Tube Metric.
- .3 Canadian Environmental Protection Act (CEPA).
  - .1 CCME PN 1326-2008, Environmental Code of Practice for Aboveground and Underground Storage Tank Systems for Petroleum Products and Allied Petroleum Products.
- .4 Canada Green Building Council (CaGBC).
  - .1 LEED Canada-NC Version 1.0-2004, LEED (Leadership in Energy and Environmental Design): Green Building Rating System Reference Package For New Construction and Major Renovations (including Addendum 2007).
  - .2 LEED Canada-CI Version 1.0-2007, LEED (Leadership in Energy and Environmental Design): Green Building Rating System Reference Guide For Commercial Interiors.
- .5 CSA International.
  - .1 CSA-B139-09, Installation Code for Oil Burning Equipment.
  - .2 CSA-B140.0-03, Oil Burning Equipment: General Requirements.
  - .3 CSA-C282-05, Emergency Electrical Power Supply for Buildings.

- .6 Green Seal Environmental Standards (GSES).
  - .1 Standard GS-11-2008, 2<sup>nd</sup> Edition, Paints and Coatings.
- .7 Health Canada / Workplace Hazardous Materials Information System (WHMIS).
  - .1 Material Safety Data Sheets (MSDS).
- .8 Manufacturers Standardization Society of the Valve and Fitting Industry (MSS).
  - .1 MSS-SP-80-08, Bronze Gate, Globe, Angle and Check Valves.
- .9 National Association of Corrosion Engineers (NACE).
  - .1 NACE SP0169-2007, Control of External Corrosion on Underground or Submerged Metallic Piping Systems.
- .10 National Fire Code of Canada (NFCC 2005).
- .11 South Coast Air Quality Management District (SCAQMD), California State, Regulation XI. Source Specific Standards
  - .1 SCAQMD Rule 1113-A2007, Architectural Coatings.
- .12 Underwriter's Laboratories of Canada (ULC).
  - .1 CAN/ULC S603.1-03, External Corrosion Protection Systems for Steel Underground Tanks for Flammable and Combustible Liquids.
  - .2 ULC ORD-C107.12-1992, Line Leak Detection Devices for Flammable Liquid Piping.

## 1.2 ADMINISTRATIVE REQUIREMENTS

- .1 Pre-Installation Meeting:
  - .1 Convene pre-installation meeting one week prior to on-site installations.
    - .1 Verify project requirements.
    - .2 Review installation conditions.
    - .3 Co-ordination with other building subtrades.
    - .4 Review manufacturer's installation instructions and warranty requirements.

### 1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
  - .1 Provide manufacturer's printed product literature, specifications and datasheets for piping, fittings and equipment and include product characteristics, performance criteria, physical size, finish, and limitations.
    - .1 Indicate on manufacturer's catalogue literature the following: Valves.
  - .3 Indicate VOC's for adhesive and solvents during application and curing.
  - .4 Test Reports:
    - .1 Submit certified test reports from approved independent testing laboratories indicating compliance with specifications for specified performance characteristics and physical properties.
  - .5 Certificates:
    - .1 Submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
  - .6 Manufacturers' Instructions: Provide manufacturer's installation instructions.

### 1.4 CLOSEOUT SUBMITTALS

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

### 1.5 QUALITY ASSURANCE

- .1 Ensure piping is installed by company and individuals authorized by authority having jurisdiction.

### 1.6 DELIVERY, STORAGE, AND HANDLING

- .1 Deliver, store, and handle materials in accordance with Section 01 61 00 - Common Product Requirements and manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements:
  - .1 Deliver materials to site in original factory packaging, labelled with manufacturer's name and address.

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## **PART 2 - PRODUCTS**

### **2.1 FILL VENT AND CARRIER PIPE**

- .1 Materials as per CSA-B139 Standard.
- .2 Steel: To ASTM A53/A53M Standard, Schedule 40, continuous weld or electric resistance welded, screwed.
- .3 Soft copper type "K" with flared connections (for engine hook-up from day tank)

### **2.2 STEEL PIPE COATING**

- .1 Epoxy Paint: In accordance with manufacturer's recommendations.
- .2 Primers, Paints and Coating: In accordance with manufacturer's recommendations for surface conditions.

### **2.3 JOINTING MATERIAL**

- .1 Screwed Fittings: Teflon tape.

### **2.4 FITTINGS**

- .1 Steel:
  - .1 Malleable iron: Screwed, banded, Class 150 to ASME-B16.3 Standard.
  - .2 Welding: Buttwelding to ASME-B16.9 Standard.
  - .3 Unions: Malleable iron, brass to iron, ground seat, screwed, to ASTM A47/A47M Standard.
  - .4 Nipples: Schedule 40, to ASTM A53/A53M Standard.

### **2.5 BALL VALVES**

- .1 NPS 2 and under: Bronze body, screwed ends, TFE seal, hard chrome ball, 4 MPa, WOG.

### **2.6 SWING CHECK VALVES**

- .1 NPS 2 and under, screwed: To MSS-SP-80 Standard, Class 125, 860 kPa, bronze body, bronze swing disc, screw in cap, and regrindable seat.
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## **PART 3 - EXECUTION**

### **3.1 APPLICATION**

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

### **3.2 PIPING**

- .1 Install piping in accordance with Section 23 05 05 - Installation of Pipework, supplemented as specified.
  - .2 Install oil piping system in accordance with CSA-B139 Standard.
  - .3 Slope piping down in direction of storage tank, unless otherwise indicated.
  - .4 Above ground piping to be protected from physical impact due to impact.
  - .5 Piping Inside Building:
    - .1 Ensure piping in solid flooring is installed to CSA-B139 Standard.
    - .2 Use approved fitting to CSA-B139 Standard for steel piping.
  - .6 Fill, vent, suction and return piping outside building:
    - .1 Steel piping throughout, except at tanks where electrically isolating fittings are used.
    - .2 Grading: Slope piping at 1% minimum back to tanks.
  - .7 Piping at Tanks:
    - .1 Suction: Terminate 50 mm from bottom of tank with foot valve.
    - .2 Return: Terminate 50 mm from bottom of tank with return bend.
    - .3 Comply with CSA-B139 Standard for piping for venting at tanks including venting whistle.
    - .4 Fill pipes: Install to comply with CSA-B139 Standard.
      - .1 Include liquid tight tamperproof cover.
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- .8 Clearly label piping runs in legible form indicating;
  - .1 Piping product content.
  - .2 Direction of flow.

### **3.3 VALVES**

- .1 Install valves with stems upright or horizontal unless approved otherwise by Departmental Representative.
- .2 Install ball valves at branch take-offs to isolate pieces of equipment and as indicated.
- .3 Install swing check valves on discharge of pumps and as indicated.

### **3.4 OVERFILL AND SPILL PROTECTION**

- .1 To CSA-B139 Standard.

### **3.5 FIELD QUALITY CONTROL**

- .1 Site Tests/Inspection:
  - .1 Test system to CSA-B139 and CSA-B140.0 Standards and authorities having jurisdiction.
  - .2 Isolate tanks from piping pressure tests.

### **3.6 CLEANING**

- .1 Clean in accordance with Section 23 08 02 - Cleaning and Start-Up of Mechanical Piping Systems and manufacturer's written recommendations, supplemented as follows:
  - .1 Flush after pressure test with No. 2 fuel oil for a minimum of two hours. Clean strainers and filters.
  - .2 Dispose of fuel oil used for flushing out in accordance with requirements of authority having jurisdiction.
  - .3 Ensure vents from regulators, control valves are terminated in approved location and are protected against blockage and damage.
  - .4 Ensure entire installation is approved by authority having jurisdiction.

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

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

**END OF SECTION**

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**Division 25 / Integrated Automation**

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## **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 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 Department 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 Information 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.
  - .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.

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- .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.
-

## 1.5 SYSTEM DESCRIPTION

- .1 Supply and install a new DDC system for local use in the pumphouse. The system shall be complete and autonomous, with a controller and color LCD touchscreen to view status of equipment and other information directly in the pumphouse.
- .2 Refer to control schematics for system architecture.
- .3 The above-mentioned sections aim at the supply and installation of a new system. Include what follows:
  - .1 Autonomous Controller.
  - .2 Control devices as listed in I/O point summary tables.
  - .3 Color LCD viewing screen with touch sensitive interface.
  - .4 Field control devices.
  - .5 Software/Hardware complete with full documentation.
  - .6 Complete operating and maintenance manuals.
  - .7 Training of personnel.
  - .8 Acceptance tests, technical support during commissioning, full documentation.
  - .9 Wiring interface co-ordination of water meter.
  - .10 Miscellaneous work as specified in these sections and as indicated.
- .4 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 Departmental Representative prior to installation.
  - .3 Location of controllers as reviewed by Departmental Representative 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.

- .5 Language Operating Requirements:
  - .1 Provide passwords to use the system in English.
  - .2 Use non-linguistic symbols for displays on graphic terminals. Display other information in English.
  - .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:
    - .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.
- .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 label or listing of specified organization is acceptable evidence.

- .4 In lieu of such evidence, submit certificate from testing organization, approved by Departmental Representative, certifying that item was tested in accordance with their test methods and that item conforms to their standard/code.
- .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 Departmental Representative.
- .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.

## **1.8 DELIVERY, STORAGE, AND HANDLING**

- .1 Material Delivery Schedule: Provide 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 Departmental Representative.
- .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 Departmental Representative.
  - .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 Departmental Representative 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 Departmental Representative 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 Departmental Representative.
  - .1 The Contractor is responsible for the repaired elements requested by the Departmental Representative.
  - .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 Departmental Representative.
  - .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 Owner'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.

## **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**

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## **PART 1 - GENERAL**

### **1.1 RELATED SECTIONS**

- .1 Section 01 33 00 - Submittal Procedures.
- .2 Section 01 91 00 - Commissioning - Mechanical and Electrical Installation.

### **1.2 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 No. 45, Rigid Steel Conduits.

### **1.3 SYSTEM DESCRIPTION**

- .1 Electrical:
    - .1 Provide power wiring from 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.
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- .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.

#### **1.4 PERSONNEL QUALIFICATIONS**

- .1 Qualified supervisory personnel to:
  - .1 Continuously direct and monitor all work.
  - .2 Attend site meetings.

### **PART 2 - PRODUCTS**

#### **2.1 WIRING**

- .1 As per requirements of Division 26.
  - .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 FT6 rated wiring where wiring is not run in conduit. All other cases use FT4 wiring.
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- .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.

## 2.2 CONDUIT

- .1 As per requirements of Division 26.
- .2 Conduits must have a minimum of 20 mm (0.79 in) 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.

### **2.3 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.

### **2.4 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.

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## **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.
  - .2 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 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, and outlet wiring during construction for personnel safety.
  - .8 Shield and mark live parts "LIVE 120 VOLTS" or other appropriate voltage.
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- .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, and 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 1/10<sup>th</sup> 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 (20 in.).
- .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 Division 26.
- .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:
  - .1 Preliminary tests:
    - .1 Conduct as directed to verify compliance with specified requirements.
    - .2 Make needed changes, adjustments, and 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-day 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**

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## **PART 1 - GENERAL**

### **1.1 RELATED SECTIONS**

- .1 Section 25 05 01 - EMCS: General Requirements.
- .2 Section 25 30 02 - EMCS: Field Control Devices.
- .3 Section 25 90 01 - EMCS: Site Requirements Applications and Systems Sequences of Operation.

### **1.2 REFERENCES**

- .1 American Society of Heating, Refrigeration and Air-Conditioning Engineers, Inc. (ASHRAE).
  - .1 ASHRAE 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 <ftp://ftp.pwgsc.gc.ca/rps/docentre/mechanical/me214-f.pdf>.

### **1.3 DEFINITIONS**

- .1 Acronyms and Definitions: Refer to Section 25 05 01 - EMCS: General Requirements.

### **1.4 SYSTEM DESCRIPTION**

- .1 The network of controllers is existing. The controllers are manufactured by Delta Controls. The new required controllers must communicate with the existing controllers.
  - .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.
-

- .3 Network of controllers has to be provided as indicated in System Architecture Diagram to support building systems and associated sequences of operations as detailed in these specifications.
  - .1 Provide sufficient controllers to meet intents and requirements of this section.
  - .2 Controller quantity, and point contents to be approved by Departmental Representative at time of preliminary design review.
- .4 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.
- .5 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.

## 1.5 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 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.
- .4 Controllers (MCU, LCU): Mount in wall mounted cabinet with hinged, keyed-alike locked door.
  - .1 Provide for conduit entrance from top, bottom or sides of panel.
  - .2 ECUs and TCUs to be mounted in equipment enclosures or separate enclosures.
  - .3 Mounting details as approved by Departmental Representative for ceiling mounting.
- .5 Cabinets to provide protection from water dripping from above, while allowing sufficient airflow to prevent internal overheating.
- .6 Interconnection cable connections must protect against over voltage and decrease in voltage.

## **1.6 SUBMITTALS**

- .1 Make submittals in accordance with section 01 33 00 - Submittal Procedures.
  - .1 Submit product data sheets for each product item proposed for this project.

## **1.7 MAINTENANCE PROCEDURES**

- .1 Provide manufacturers recommended maintenance procedures for insertion.

## **PART 2 - PRODUCTS**

### **2.1 GENERAL NOTE**

- .1 Supply and install an autonomous controller to support the schematic control layout on drawing. The controller shall communicate with a touch-sensitive LCD display acting as user interface.

## 2.2 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 Delta 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.
    - .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, setpoints, alarm limits, PID constants and CDL, and hence modifiable on-line through operator panel or remote operator's interface. RAM to be downloadable from OWS.
  - .4 Include uninterruptible clock accurate to plus or minus 5 sec./month, capable of deriving year/month/day/hour/minute/second, with rechargeable batteries for minimum 72-hour operation in event of power failure.

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- .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 setpoints.
      - .3 Modify PID loop parameters.
      - .4 Override PID control.
      - .5 Change time/date.
      - .6 Add/modify/start/stop weekly scheduling.
      - .7 Add/modify setpoint weekly scheduling.
      - .8 Enter temporary override schedules.
      - .9 Define holiday schedules.
      - .10 View analog limits.
      - .11 Enter/modify analog warning limits.
      - .12 Enter/modify analog alarm limits.
      - .13 Enter/modify analog differentials.
    - .5 Provide access to real and calculated points in controller to which it is connected or to other controller in network. This capability not to be restricted to subset of predefined "Global Points", but to provide totally open exchange of data between OT and other controller in network.
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- .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.

### 2.3 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, and 4 DOs.
- .3 Points integral to one Building System to be resident on only one controller.
- .4 Microprocessor capable of supporting necessary software and hardware to meet specified requirements as listed in previous MCU article with following additions:
  - .1 Include minimum 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.

### 2.4 SOFTWARE

- .1 General.
  - .1 Include as minimum: Operating system executive, communications, application programs, operator interface, and systems sequence of operation - CDL's.

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- .2 Include "firmware" or instructions which are programmed into ROM, EPROM, EEPROM or other non-volatile memory.
  - .3 Include initial programming of controllers for entire system.
  - .2 Program and Data Storage.
    - .1 Store executive programs and site configuration data in ROM, EEPROM or other non-volatile memory.
    - .2 Maintain CDL and operating data including 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 (CDL) software 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. Owner must have access to these algorithms for modification or to be able to create new ones and to integrate these into CDLs on BC(s) from OWS.
    - .2 Write CDL in high level language that allows algorithms and interlocking programs to be written simply and clearly. Use parameters entered into system (e.g. setpoints) 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
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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.

- .8 Energy Management Programs: Include specific summarizing reports, with date stamp indicating sensor details which activated and or terminated feature.
  - .1 Programs to be executed automatically without need for operator intervention and be flexible enough to allow customization.
  - .2 Apply programs to equipment and systems as specified or requested by the Departmental Representative.
- .9 Function/Event Totalization: Features to provide predefined reports which show daily, weekly, and monthly accumulating totals and which include high rate (time stamped) and low rate (time stamped) as well as 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 (e.g. 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 one 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.
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- .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**

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## **PART 1 - GENERAL**

### **1.1 RELATED SECTIONS**

- .1 Section 25 05 01 - EMCS: General Requirements.
- .2 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 (19<sup>th</sup> Edition) Safety Standard for Electrical Instalaltions.

### **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 01 33 00 - Submittal Procedures.
  - .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 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.
- .9 Measure Range: As required by each system.

### 2.2 PRESSURE TRANSMITTERS

- .1 Characteristics:
  - .1 Combined pressure transmitters.
    - .1 Internal materials: Suitable for continuous contact with industrial standard instrument air, compressed air, water, steam, as applicable.
  - .2 Output signal: 4 - 20 mA into 500 ohms maximum load.

- .3 Output variations: Less than 0.2% full scale for supply voltage variations of  $\pm 10\%$ .
- .4 Combined non-linearity, repeatability, and hysteresis effects: Not to exceed  $\pm 0.5\%$  of full scale output over entire range.
- .5 Temperature effects: Not to exceed  $\pm 1.5\%$  full scale/50 °C.
- .6 Over-pressure input protection to at least twice rated input pressure.
- .7 Output short circuit and open circuit protection.
- .8 Precision in the order of  $\pm 1\%$  on the full scale.

## 2.3 SOLID STATE RELAYS

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

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## 2.4 CURRENT TRANSDUCER

- .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 VDC.
    - .3 0-10 VDC.
    - .4 0-20 VDC.
  - .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.

## 2.5 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.

## 2.6 TOUCH-SENSITIVE LCD USER INTERFACE

- .1 Completely integrated interface communicating with controller.
- .2 Wall mounted.

## 2.7 WIRING

- .1 In accordance with Section 26 27 26 - Wiring Devices.
-

- .2 For wiring under 70 V 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 I enclosure or as required for specific applications. Provide for electrolytic isolation in cases when dissimilar metals make contact.
- .4 Support field-mounted panels, transmitters and sensors on pipe stands or channel brackets.
- .5 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 and in service rooms, and exposed wiring must be in conduit.

### **3.2 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.

**END OF SECTION**

## **PART 1 - GENERAL**

### **1.1 SEQUENCES**

- .1 Present sequencing of operations for systems, in accordance with IM 250005 - 2009: Energy Management and Control Systems (EMCS) Design Manual.

### **1.2 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 equipments (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 Zero flow or low water shut-off of pumps.

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.

- .5 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.
- .6 Program trend log points for all the input and output analog points and variables that change in the time.
- .7 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

### 1.3 DOMESTIC WATER FLOWMETER AND PUMPS

- .1 The meter is provided by Division 23. Connect the signal to the control system. Program a point indicating the actual flow. Create a table of hourly, daily, min/max daily, and monthly consumptions for the last 12 months. Record all daily and monthly values in a historical point.
- .2 Under normal conditions, pump #1 or pump #2 will be the leading pump. The pump lead will be changed weekly on Sunday morning at 4:00 AM. If the lead pump fails, the other pump will start and pump #3 shall be the next pump in sequence.
- .3 When the system flow exceeds the capacity of lead pump (120 USGPM), the second pump will be started and will run until the flow is below 100 USGPM, at which point only the lead pump will be running. Pump #3 will be started when flow exceeds 240 USGPM and stopped when flow is below 200 USGPM. Future pump #4 will be started when flow exceeds 740 USGPM and stopped when flow is below 700 USGPM.
- .4 Existing low level switch (LSL102) will shut off all pumps.

## **PART 2 - PRODUCTS**

### 2.1 NOT USED

- .1 Not Used.

**PART 3 - EXECUTION**

**3.1 NOT USED**

.1 Not Used.

**END OF SECTION**

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**Division 26 / Electrical**

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## **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 C22.1-12, Canadian Electrical Code, Part 1 (latest edition in force at work), 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, 7<sup>th</sup> 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.

## 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 Alberta, 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 Departmental Representative of these changes before they are made.
- .3 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 FIELD QUALITY CONTROL PART 3, a written report of the manufacturer showing that 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.
- .3 Site visits with the Departmental Representative shall be provided. The cost of these visits is an integral part of the Contract.

### **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 Control panels and components shall be assembled in the factory. Material and equipment to be CSA certified.

### **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: Complying with the requirements of the Departmental Representative.

### **2.4 WIRING TERMINATIONS**

- .1 Ensure lugs, terminals, and screws used for termination of wiring are suitable for copper 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
Size 2	12 x 70 mm	1 line	5 mm high
Size 3	12 x 70 mm	2 lines	3 mm high
Size 4	20 x 90 mm	1 line	8 mm high
Size 5	20 x 90 mm	2 lines	5 mm high
Size 6	25 x 100 mm	1 line	12 mm high
Size 7	25 x 100 mm	2 lines	6 mm high

- .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, and number of the feeding panels with their respective circuits.
- .7 Transformers: Indicate capacity, primary, and secondary voltages.
- .8 Identify the receptacles and lighting switches with plastic pressure sensitive label (Brother P-Touch), indicating the number of the feeding panels with their respective circuits. The labels must be white with black letters.
- .9 Do the identification of each circuit in the modified panels and new panels in new dactylographic tables. Panel dactylographic tables to be approved by Departmental Representative prior to manufacture and/or installation.

- .10 Equipment identification is to match the existing identification, if applicable.

## 2.6 WIRING IDENTIFICATION

- .1 Identify wiring with permanent indelible identifying markings and 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 ( $\geq 20$  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 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).

USE OF WIRING IN 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 Canadian Electrical Code, CSA C22.10, Part 1 (Effective edition).

### 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 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 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 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.

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- .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.

### **3.6 UNIFORMITY**

- .1 The Contractor shall comply with a perfect homogeneity between the different systems for each specialty.
- .2 The Departmental Representative 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 from Departmental Representative.
- .3 No 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.

### **3.7 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.

### **3.8 FIELD QUALITY CONTROL**

- .1 Before closing the wall, the Contractor shall notify, verbally, and in writing, the Departmental Representative. The Departmental Representative, if desired, will inspect the installations.
- .2 The Contractor shall ensure the presence of skilled personnel and availability of measuring devices and testing to perform the tests requested by the Departmental Representative to his satisfaction. In addition, any test requested by the Departmental Representative shall be executed at no additional charge. The Departmental Representative 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.
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- .3 All tests should take place with the permission of the Departmental Representative and other contractors involved. Any imperfection or defects discovered during testing must be corrected to the satisfaction of the Departmental Representative.
  - .4 Provide measuring devices, equipment and personnel needed to carry out testing during the installation and completion.
  - .5 Perform the following tests in accordance with Section 01 45 00 - Quality Control:
    - .1 Electricity distribution network, including the phase control, voltage, 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 Fire alarm system and communication network. Obtain a certificate of operation issued by a recognized authority.
    - .6 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.
    - .7 Check continuity of the grounding.
  - .6 Perform tests in presence of Departmental Representative.
  - .7 Provide equipment, gauges, and personnel required for carrying out the tests during the construction work and the completion thereof.
  - .8 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.
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- .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.
- .9 Submit test results to the Departmental Representative.

### **3.9 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 rust.
- .3 Clean the inside and top of the distribution panels, motor starters, and any other electrical enclosures.

**END OF SECTION**

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## **PART 1 - GENERAL**

### **1.1 GENERAL**

- .1 Work includes, without limitation, the provision, manufacture, design appropriate, assembly, wiring, installation, connection, inspection, painting, testing factory, providing all labor, handling, storage, anchoring, leveling, transport, delivery, assembly, disassembly, dismantling and testing on site and the warranty for all equipment and components provided.
- .2 The drawings and specifications are complementary. Any facility or equipment shown in the drawings, even if not particularly specified in the Specifications, or vice versa, is part of bid documents as specified and shown in the specifications.
- .3 Provide all materials, labor, tools, lifting equipment (if required), scaffolding, temporary supports to the structure and services needed to carry out the Work.
- .4 The Work must be complete, functional, and safe.

### **1.2 SCOPE OF WORK**

- .1 Without limitation, Work includes supply, installation, and wiring systems and equipment:
  - .1 Distribution network included:
    - .1 Safety switch.
    - .2 Ducts and wiring.
    - .3 Connection of all electrical equipment supplied by other disciplines.
    - .4 Grounding network and associated hardware.
    - .5 Demolition, disassembly and relocation of equipment, as shown or indicated on drawings.
    - .6 Commissioning of systems, equipment, and components as required in Division 01.

## **PART 2 - PRODUCTS**

### **2.1 NOT USED**

- .1 Not Used.
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**PART 3 - EXECUTION**

**3.1 NOT USED**

.1 Not Used.

**END OF SECTION**

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## **PART 1 - GENERAL**

### **1.1 DEMOLITION**

- .1 Remove all existing electrical equipment indicated on drawings. 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 drawings related thereto.
- .2 All existing equipment to remove:
  - .1 To be completely removed from its supply point to its point of use, unless indicated on drawing.
  - .2 The Contractor must offer all equipment removed to EMSI. These elements become the property of the Contractor if EMSI does not wish to recover them. The Contractor shall dispose of it promptly.
- .3 All existing equipment to remove and relocate:
  - .1 To be relocated to a location specified by redevelopment plans.
  - .2 Where indicated on drawings, 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.

### **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 Work, 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**

### **2.1 NOT USED**

- .1 Not Used.

## **PART 3 - EXECUTION**

### **3.1 NOT USED**

- .1 Not Used.

**END OF SECTION**

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**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 C22.2 No.65, Wire Connectors.
    - .1 CSA C22.2 No. 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 complying with 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 CAN/CSA C22.2 No. 18 Standard.
-

**PART 3 - EXECUTION****3.1 INSTALLATION**

- .1 Remove insulation carefully from ends of conductors and:
  - .1 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 Standard.
  - .2 Install fixture type connectors and tighten. Replace insulating cap.
  - .3 Install bushing stud connectors in accordance with EEMAC 1Y 2.
  - .4 If needed, make the grounding and bonding in accordance with CSA C22.2 No. 41 Standard.

**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 Conductor numbers and sizes are indicated on drawings. If not indicated, the Contractor must never take class lower than Electrical Code 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. The Contractor shall apply correction factors required by the Electrical Code.

**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 single phase circuit must have dedicated neutral conductor.

## **2.2 TECK 90 CABLE**

- .1 Cables complying with CAN/CSA C22.2 No. 131 Standard.
- .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 Armor: 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 "U" channels.
- .8 Connectors:
  - .1 Watertight, approved for TECK cable.

## **2.3 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°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 cables on "U" supports.
- .2 Finish the ends of cables in accordance with Section 26 05 20 - Wire and Box Connectors (0-1,000 V).
- .3 Use TECK cable only when indicated on drawings.

#### **3.3 INSTALLATION OF CONTROL CABLES**

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

**END OF SECTION**

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## **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.
-

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## **PART 3 - EXECUTION**

### **3.1 INSTALLATION GENERAL**

- .1 Existing grounding shall be verified for the condition and grounding resistance before any new connection take place.
- .2 Install complete permanent, continuous grounding system including, conductors, connectors, accessories. Where EMT is used, run green ground wire in each conduit.
- .3 Install connectors in accordance with manufacturer's instructions.
- .4 Protect against damage conductors grounded posed uncovered.
- .5 Use mechanical connectors for grounding connections to equipment provided with lugs.
- .6 The welded joints are prohibited.
- .7 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.
- .8 Arrange grounding conductors in radial form and route all the connections directly to a single point of common ground. Avoid loopbacks.
- .9 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.
- .10 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 BUS GROUNDING**

- .1 Install the copper bus bars on isolated supports fixed to the wall of electrical room.
-

- .2 Connect the equipment of the electrical room to the ground bus bar, using individual conductors of bare copper, stranded, size 2/0 AWG.

### **3.5 SYSTEMS COMMUNICATION**

- .1 Perform connections grounded telephone systems, public address, fire alarm, and intercom, as follows:
  - .1 Phone: Install the ground as required by the telephone company and/or the Departmental Representative.
  - .2 Sound, intercom and fire alarm: As required by the manufacturer.

### **3.6 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 Support equipment, conduit, or cables using clips, spring loaded bolts, and cable clamps designed as accessories to basic channel members.
- .5 Fasten exposed conduit or cables to building construction or support system using straps.
  - .1 One-hole 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.
- .6 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.
- .7 For surface mounting of two or more conduits use channels at 1.5 m on centre spacing.
- .8 Provide metal brackets, frames, hangers, clamps, and related types of support structures where indicated or as required to support conduit and cable runs.
- .9 Ensure adequate support for raceways and cables dropped vertically to equipment where there is no wall support.
- .10 Do not use wire lashing or perforated strap to support or secure raceways or cables.
- .11 Do not use supports or equipment installed for other trades for conduit or cable support, unless it has obtained permission from the latter and the approval of the Departmental Representative.
- .12 Install fastenings and supports as required for each type of equipment cables and conduits, and in accordance with manufacturer's installation recommendations.

**END OF SECTION**

## **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 C22.10, Canadian Electric Code, Part 1 (Effective version).

## **PART 2 - PRODUCTS**

### **2.1 SPLITTERS**

- .1 Construction: Sheet metal enclosure, welded corners, and formed hinged cover suitable for locking in closed position.
- .2 Terminations: Main and branch lugs to match required size and number of incoming and outgoing conductors as indicated.
- .3 Provide at least three terminals provided for each series of pods splitting boxes with a current rating less than 400 A.

### **2.2 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.

### **2.3 CABINETS**

- .1 E-type cabinet, sheet steel, surface mount, fitted with a hinged door with sides folded over the sides, a handle, and a latch.

## **PART 3 - EXECUTION**

### **3.1 SPLITTER INSTALLATION**

- .1 Mount plumb, true, and square to building lines.
-

- .2 Extend splitters full length of equipment arrangement, except where indicated otherwise.

### **3.2 JUNCTION, PULL BOXES AND CABINETS INSTALLATION**

- .1 Install pull boxes in 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.

### **3.3 IDENTIFICATION**

- .1 Supply and install identification tags of equipment in accordance with Section 26 05 00 - Common Work Results - Electrical for the results of Work.
- .2 Install a Type 2 label indicating the name of the network, voltage, and number of phases.

**END OF SECTION**

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**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 Standard.
- .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**

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**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: Complying with CSA C22.2 No. 45 Standard, hot dipped galvanized steel threaded.
- .2 Electrical metallic tubing (EMT) according to CSA C22.2 No. 83 Standard, with couplings with expanded ends and a green wire to bonding.
- .3 Flexible metal conduit in accordance with CSA C22.2 No. 56 Standard, 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. Two holes steel straps for conduits larger than 53 mm.
- .2 Beam clamps to secure conduits to exposed steel work. "U" stirrups 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 epoxy coated conduit in corrosive areas.
- .5 Use electrical metallic tubing (EMT) except in cast concrete, and when they are not subject to mechanical injury.
- .6 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.
- .7 Use rigid PVC conduit underground or waterproof.
- .8 Use flexible metal conduit in case of installation of removable metallic partition.
- .9 Use flexible metal conduit for connection to motors and other equipment subject to vibrations in dry areas. Total length not to exceed 1 m.
- .10 Daisy chain connections are not permitted.

- .11 Bend conduit cold. Replace conduit if kinked or flattened more than 1/10<sup>th</sup> of its original diameter.
- .12 Mechanically bend steel conduit over 21 mm diameter.
- .13 Field threads on rigid conduit must be of sufficient length to draw conduits up tight.
- .14 Install fish cord in empty conduits.
- .15 Remove and replace blocked conduit sections. Do not use liquids to clean out conduits.
- .16 Dry conduits out before installing wire.
- .17 Install a metal support in the ceiling "T" for installation of exit signs and fire detectors.
- .18 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**

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## **PART 1 - GENERAL**

### **1.1 RELATED SECTIONS**

- .1 Section 01 33 00 - Submittal Procedures.
- .2 Section 26 05 00 - Common Work Results - Electrical.

### **1.2 REFERENCES**

- .1 Canadian Standards Association (CSA International).
  - .1 CSA-C22.2 No. 42, General Use Receptacles, Attachment Plugs and Similar Devices.
  - .2 CSA-C22.2, No. 42.1, Cover Plates for Flush-Mounted Wiring Devices (Bi-national Standard, with UL 514D).
  - .3 CSA-C22.2, No. 55, Special Use Switches.
  - .4 CSA-C22.2, No. 42, General Use Receptacles, Attachment Plugs and Similar Devices.
  - .5 CSA-C22.2, No. 111, General-Use Snap Switches (Bi-national standard, with UL 20, twelfth edition).

### **1.3 SHOP DRAWINGS AND PRODUCT DATA**

- .1 Submit shop drawings and product data in accordance with Section 01 33 00 - Submittal Procedures.

## **PART 2 - PRODUCTS**

### **2.1 SWITCHES**

- .1 Switches: SPDT 347 V in accordance with CSA C22.2 No. 55, Grade Heavy Duty Specification Grade.
  - .2 Switches: Manually operated, use universal AC having the following characteristics:
    - .1 Connection Ports: son to size 10 AWG.
    - .2 Contacts: Silver alloy.
-

- .3 Elements molded in resin or melamine urea to counter the effects of carbon deposits.
- .4 Connection: Back or side.
- .5 Switches: Ivory color to normal network and red for the emergency network.
- .3 Switches: Rocker rated by the full load in the case of fluorescent lighting fixtures and bulbs, corresponding to 120% load, in the case of engines.
- .4 For entire Work, use only switches from a single manufacturer.

## 2.2 RECEPTACLES

- .1 Duplex receptacles, "Specification Grade" type, 125 V, 15 A, "U" ground, according to CSA C22.2 No. 42, Grade Heavy Duty Specification Grade with the following characteristics:
  - .1 Urea moulded housing ivory for normal network, red for the emergency network, and receptacles with isolated grounding to be colour orange.
  - .2 Suitable for No. 10 AWG for back and side wiring.
  - .3 Break-off links for use as split receptacles.
  - .4 Eight back wired entrances, four side wiring screws.
  - .5 Triple wipe contacts and riveted grounding contacts.
- .2 Outlets simple type CSA 5 15 R, 125 V, 15 A, "U" socket grounding, with the following characteristics:
  - .1 Molded resin urea ivory.
  - .2 For connection side or rear son size 10 AWG.
  - .3 Four rear connection ports, two screw terminals for connection side.
- .3 Other receptacles with ampacity and voltage as indicated in drawing.
- .4 Receptacles for cleaning, designed for 15 A and 20 A must be 5-20R configuration.
- .5 Receptacles of one manufacturer throughout project.

### 2.3 GROUND RECEPTACLE (GFI)

- .1 Double protected receptacle for 15 A circuit, 120 V, including:
  - .1 Leak detector land, semi-conductors.
  - .2 Test device and reset.
  - .3 CSA approved enclosure, mounted flush with stainless steel faceplate.

### 2.4 COVER PLATES

- .1 Provide cover plates for wiring devices according to CSA C22.2 No. 42.1 Standard.
- .2 Cover plates from one manufacturer throughout project.
- .3 Sheet metal cover plates for wiring devices mounted in surface-mounted FS or FD type conduit boxes.
- .4 Stainless steel, vertically brushed, 1 mm thick cover plates for wiring devices mounted in flush-mounted outlet box.
- .5 Cover plate: plate for wiring devices mounted in boxes for conduit type FS or FD, mounted projection.
- .6 Cover plate castings, aluminum, weatherproof, double-leaf spring with seals for double sockets, as shown in the drawing
- .7 Cover plate castings, aluminum, spring, weather proof, with gaskets for electrical outlets or switches simple as indicated in the plans.
- .8 Weatherproof double lift spring-loaded cast aluminum cover plates, complete with gaskets for duplex receptacles installed outdoor or in humid locations.

## **PART 3 - EXECUTION**

### 3.1 INSTALLATION

- .1 Switches:
  - .1 Install the switches to one lane so that the handle is up when the contacts are closed.
  - .2 Install switches in outlet boxes, when it takes more than one switch in one place. Provide accessories and mounts.

- 
- .3 Install toggle switches to the height prescribed in Section 26 05 00 - Common Work Results - Electrical for the results of Work or as directed by the drawings.
  - .4 Install the switches near the doors on the side of the handle.
  - .2 Receptacles:
    - .1 Install receptacles in gang type outlet box when more than one receptacle is required in one location.
    - .2 Mount receptacles at height in accordance with Section 26 05 00 - Common Work Results - Electrical or as indicated.
    - .3 Do not connect wiring only with screws.
  - .3 Ground Receptacle (GFI):
    - .1 The neutral must not be grounded on the load side of relay ground fault.
    - .2 The phase conductors including the neutral must pass through transformers homopolar field.
    - .3 Install receptacle at the height prescribed in Section 26 05 00 - Common Work Results - Electrical for the results of Work or as directed by the drawings.
    - .4 Connect the power wiring and load the appropriate equipment, as indicated, following the manufacturer's instructions.
  - .4 Cover Plates:
    - .1 Protect stainless steel cover plate finish with paper or plastic film until painting and other work is finished.
    - .2 Install suitable common cover plates where wiring devices are grouped.
    - .3 Do not use cover plates meant for flush outlet boxes on surface-mounted boxes.
  - .5 All the receptacles installed at less than 1 m from a wash basin or a sink must be protected by a GFI breaker at the panelboard or GFI receptacle.
  - .6 Do not install back to back outlets. A minimum 150 mm horizontal space must be left between boxes.
-

### **3.2 TESTS**

- .1 Demonstrate for receptacle ground (GFI) by simulating grounded fault.

**END OF SECTION**

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## **PART 1 - GENERAL**

### **1.1 RELATED SECTIONS**

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

### **1.2 REFERENCES**

- .1 Canadian Standards Association (CSA).
  - .1 CSA C22.2 No. 248.12, Low voltage fuses - Part 12: Class R Fuses (Bi-national Standard UL 248 12, 1<sup>st</sup> Edition).
  - .2 CSA C22.2 No. 106, Fuses with a High Breaking Capacity (HRC-MISC).

## **PART 2 - PRODUCTS**

### **2.1 FUSES - GENERAL.**

- .1 Fuses type L1, L2, J1, and R1 have been accepted for use within the present Work.
- .2 Fuses : Product of a single manufacturer for the entire project.

### **2.2 TYPES OF FUSES**

- .1 Class L Fuses (formerly The HRC).
    - .1 Type L1: Deferred action can support a current equal to 500% of its rated current for at least 10 s.
    - .2 Type L2: Pet Instant distribution arteries.
  - .2 Class J Fuses (formerly J HRCI).
    - .1 Type J1: Deferred action can support a current equal to 500% of its rated current for at least 10 seconds for transformers and motors.
    - .2 Type J2: Pet Instant distribution arteries.
-

## **PART 3 - EXECUTION**

### **3.1 INSTALLATION**

- .1 Insert the fuses in the fuse immediately before switching on the circuit.
- .2 Ensure that the fuses are inserted in the appropriate fuse and perfectly matched.
- .3 Ensure that the correct fuses are inserted in the appropriate place to protect the designated circuit.

**END OF SECTION**

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**PART 1 - GENERAL****1.1 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, 10<sup>th</sup> Edition, and NMX-J-266-ANCE, 2<sup>nd</sup> Edition).

**1.2 SUBMITTALS**

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

**PART 2 - PRODUCTS****2.1 BREAKERS GENERAL**

- .1 Moulded-Case Circuit Breakers: To CSA C22.2, No. 5 Standard.
- .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.

**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**

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**PART 1 - GENERAL****1.1 RELATED SECTIONS**

- .1 Section 26 05 00 - Common Work Results - Electrical.
- .2 Section 26 28 13.01 - Fuses - Low Voltage.

**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 CAN/CSA C22.2 No. 4 Standard, 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 drawing 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.

## **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.
- .3 Do wiring and connections required for auxiliary contacts to motor starter or drive associated.

**END OF SECTION**

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**Division 33 / Utilities**

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## **PART 1 - GENERAL**

### **1.1 REFERENCES**

- .1 American National Standards Institute (ANSI).
    - .1 ANSI/NFPA-329, Handling Underground Releases of Flammable and Combustible Liquids.
    - .2 ANSI/API 650, Welded Steel Tanks for Oil Storage.
  - .2 American Petroleum Institute (API).
    - .1 API STD 653, Tank Inspection, Repair, Alteration, and Reconstruction.
  - .3 Canadian Council of Ministers of the Environment (CCME).
    - .1 CCME-PN1326, Environmental Code of Practice for Aboveground and Underground Storage Tank Systems Containing Petroleum and Allied Petroleum Products.
  - .4 Department of Justice Canada (Jus).
    - .1 Canadian Environmental Protection Act, (CEPA).
  - .5 Canadian Standards Association (CSA)/CSA International.
    - .1 CAN/CSA-B139, Installation Code for Oil Burning Equipment.
  - .6 The Master Painters Institute (MPI).
    - .1 Architectural Painting Specification Manual.
  - .7 National Research Council/Institute for Research in Construction.
    - .1 NRCC 38727, National Fire Code of Canada (NFC).
  - .8 Transport Canada (TC).
    - .1 Transportation of Dangerous Goods Act, (TDGA).
  - .9 Underwriters Laboratories of Canada (ULC).
    - .1 ULC/ORD-C58.12, Leak Detection Devices (Volumetric Type) for Underground Storage Tanks.
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- .2 ULC/ORD-C58.14, Leak Detection Devices (Non-volumetric Type) for Underground Storage Tanks.
- .3 ULC/ORD-C58.15, Overfill Protection Devices for Underground Tanks.
- .4 ULC/ORD-C107.7, Glass-Fibre Reinforced Plastic Pipe and Fittings.
- .5 ULC/ORD-C107.19, Secondary Containment of Underground Piping.
- .6 ULC/ORD-C142.23, Aboveground Waste Oil Tanks.
- .7 ULC-S601, Shop Fabricated Steel Aboveground Horizontal Tanks for Flammable and Combustible Liquids.
- .8 ULC-S602, Aboveground Steel Tanks for Fuel Oil and Lubricating Oil.
- .9 ULC-S652, Tank Assemblies for Collection of Used Oil.

## **1.2 SUBMITTALS**

- .1 Submit shop drawings in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Indicate details of construction, appurtenances, installation, and leakage detection system.
- .3 Shop drawings to detail and indicate following, as applicable to project requirements. Submit manufacturer's product data to supplement shop drawings.
  - .1 Size, materials, and locations of ladders, ladder cages, catwalks, and lifting lugs.
  - .2 Tanks capacity.
  - .3 Size and location of fittings.
  - .4 Environmental compliance package accessories.
  - .5 Decals, type, size, and location.
  - .6 Accessories: Provide details and manufacturers product data.
  - .7 Size, material, and location of manholes.
  - .8 Size, materials, locations of railings, stairs, ladders, and walkways.
  - .9 Finishes.
  - .10 Electronic accessories: Provide details and manufacturers product data.

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- .11 Insulation types, locations, and RSI values.
  - .12 Identification, name, address, and phone numbers of corrosion expert, where applicable. Note: Grading drawings to be stamped by licenced corrosion expert.
  - .13 Piping, valves, and fittings: Type, materials, sizes, piping connection details, valve shut-off type, and location.
  - .14 Spill containment: Provide description of methods and show sizes, materials, and locations for collecting spills at connection point between storage tank system and delivery truck, or vessel.
  - .15 Anchors: Description, material, size, and locations.
  - .16 Concrete: Type, composition, and strength.
  - .17 Size and location of site pads.
  - .18 Level gauging: Type and locations, include:
    - .1 Reporting systems, types of reports, and report frequency.
    - .2 Maximum number of tanks to be monitored.
    - .3 Number of probes required and sizes.
    - .4 Provide details and manufacturer's product data.
  - .19 Ancillary devices: Provide details and manufacturer's product data.
  - .20 Leak detection system, type, and locations, as well as alarm system.
  - .21 Grounding and bonding: Provide details of design, type, materials, and locations.
  - .22 Corrosion protection: Provide details of design, type, materials, and locations.
  - .23 Field-erected overfill-protection systems: Provide details of design, type, materials, and locations.
  - .24 Containment system for spills, overfills, and storm runoff water: Provide details, materials used, and locations.
- .4 Provide maintenance data for tank appurtenances and leakage detection system for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.
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### 1.3 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 all packaging materials and appropriate recycling facilities.
  - .3 Collect and separate for disposal paper, plastic, polystyrene, corrugated cardboard, and packaging material in appropriate on-site bins for recycling in accordance with Waste Management Plan.
  - .4 Separate for reuse and recycling and place in designated containers steel, metal, and plastic waste in accordance with Waste Management Plan.
  - .5 Place Materials defined as hazardous or toxic in designated containers.
  - .6 Handle and dispose of hazardous materials in accordance with the CEPA, TDGA, and Regional and Municipal regulations.
  - .7 Clearly label location of salvaged material's storage areas and provide barriers and security devices.
  - .8 Ensure emptied containers are sealed and stored safely.
  - .9 Divert unused metal materials from landfill to metal recycling facility as approved by Departmental Representative.
  - .10 Divert unused concrete materials from landfill to local quarry facility as approved by Departmental Representative.
  - .11 Dispose of unused paint or coating materials at an official hazardous material collections site as approved by Departmental Representative.
  - .12 Do not dispose of unused paint, thinners, solvents, etc., into sewer system, into streams, lakes, onto ground, or in other location where it will pose health or environmental hazard.
  - .13 Fold up metal banding, flatten, and place in designated area for recycling.
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## **PART 2 - PRODUCTS**

### **2.1 ABOVE GROUND FUEL OIL STORAGE TANK (DOUBLE WALL)**

- .1 Provide packaged, factory fabricated, and tested fuel oil storage tank, as specified, including double walled steel tank welded to steel support legs.
- .2 Tank Construction:
  - .1 Horizontal cylindrical double walled (300°-360° secondary containment) fabricated and certified to ULC S 601 Standard.
  - .2 Material: Low carbon steel.
  - .3 Exterior coating: Factory-applied, primer coat to CAN/CGSB-1.181 Ready Mix Organic Zinc-Rich Coating, two (2) coats of suitable corrosion resistant epoxy paint, and one (1) top coat of suitable polyurethane paint.
  - .4 Fittings: Vent opening c/w vent pipe (size and length as required) with 180° close bend, fill opening c/w fill tube, locking cap, and spill containment device, 50 mm diameter tapping for each suction, 50 mm for return, one 100 mm tapping for level gauge, one 100 mm diameter spare tapping (threaded and plugged), and vacuum gauge tapping.
  - .5 Vacuum applied to interstitial space with vacuum gauge.
- .3 Tank Support:
  - .1 Two (2) steel support saddles welded to tank drilled for holddown anchor bolts.
- .4 Accessories:
  - .1 Spill containment device on fill pipe c/w locking 50 mm tight fill cap, collar, and drain valve.
  - .1 Level gauge, float type with site glass.
  - .2 Emergency vent device.
  - .3 Vacuum gauge (tank mounted).
  - .4 Lifting lugs.
  - .5 Grounding lug.
  - .6 Pipe support bracket on end of tank.

- .7 Overfill protection to CCME.
- .5 Size: 2,200 L, 1,828 mm long x 1,276 mm diameter.
- .6 Anchored to concrete base with four (4) anchor bolts.

## 2.2 DIESEL DAY TANK

- .1 Provide packaged, factory fabricated, and tested fuel-oil storage day tank consisting of one fuel tank, an Electronic Control Module (ECM), and fuel supply pumps. The fuel day tank system shall automatically maintain fuel levels specified within.
- .2 Fuel Day Tank capacity shall be based on NEC 2011, NFPA 70, Article 701.12 (B) (2) where internal combustion engines are used as the prime mover, an on-site fuel supply shall be provided with an on-premise fuel supply sufficient for not less than two (2) hours of full-demand operation of the system. The day tank shall be sized in accordance with these standards and the capacity shall not be less than 227 liter.
- .3 Fuel Day Tank shall be made of heavy gauge steel construction. Tank shall include removable, welded steel top cover for indoor applications. Tank shall be coated with rust inhibitor within inner tank, primed and finish painted on external tank. The installing contractor shall provide Schedule 40, ASTM A 53, black iron pipe connections to the day tank fittings. All connections to be made with pipe unions to facilitate tank service/removal. The tank shall include at a minimum the following fittings:
  - .1 NPT 1 engine supply.
  - .2 NPT 1 engine return.
  - .3 NPT 2 fitting for emergency vent, sized per the requirements of NFPA 30 and UL-142/ULC-S601 Requirements.
  - .4 NPT 1 overflow.
  - .5 NPT 2 normal vent.
  - .6 4 ½ in. sq. inspection port below electrical controls.
- .4 Emergency vent cap shall be spring-pressure operated. Opening Pressure shall be 0.5 psig; full opening pressure 2.5 psig. Flow rate shall be marked on top of each vent.
- .5 Fuel Day Tank Control, Alarm and Status Display.
  - .1 The microprocessor-based electronic control module (ECM) shall be specified for control of redundant pump operation. The ECM shall receive a signal from a single electrical analog float sensor. The ECM shall be provided with the

following indications: fuel level, alarm, function, and existing warning and shutdown conditions, and be located within a Type 1 zinc-plated enclosure for indoor use. The lamps shall be high-intensity LED type. The lamp condition shall be clearly apparent under bright room lighting conditions. All warnings shall be provided with normally open and normally closed, dry contacts for remote annunciation (3 amps at 120 VAC).

- .6 Fuel Level Display.
    - .1 Full - 100% Green LED indicator.
    - .2 95% - Green LED indicator.
    - .3 85% - Green LED indicator.
    - .4 75% - Yellow LED indicator.
    - .5 50% - Yellow LED indicator.
    - .6 25% - Yellow LED indicator.
    - .7 10% - Yellow LED indicator.
    - .8 Empty - 6% - Red LED indicator.
  - .7 Alarm Display.
    - .1 High Fuel - 106% or greater of capacity.
    - .2 Low Fuel - 62% of capacity.
    - .3 Critical Low Fuel - 6% of capacity.
    - .4 Fuel within containment.
    - .5 ECM functional - Tank fault.
  - .8 Function Display.
    - .1 Power on: This button activates the ECM after the "Off" button has been depressed. On any initial power up condition, after a power outage, the ECM shall be in an on condition.
    - .2 Pump running: For redundant pump operation fuel pump control panel shall indicate Pump A or Pump B running.
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- .9 Mode.
- .1 On - Power available to ECM.
  - .2 Off - Turns off power within ECM.
  - .3 Test - Shall force supply pump(s) to operate at time of start-up to verify that overflow return line has been piped correctly and that there are no leaks within the system.
- .10 Start-up test switch shall test contacts for high, low, critical low, ECM functional, and containment switch to assure wiring of remote contacts is correct.
- .11 Critical high-level automatic discrete shut-off switch shall supply pump delivery to the fuel day tank at the tank critical high liquid level. The critical high-level fuel switch shall be hard-wired to override any other alarms or signals received by the ECM.
- .12 Pump Operation.
- .1 Two supply pumps and motors are supplied and the pumps shall alternate as the lead when refueling day tank. The lead pump shall activate when fuel level decreases to 87% of capacity; the lag pump shall activate in tandem with the lead pump if the fuel level decreases to 75% of capacity. The supply pump operation shall stop at 100% of tank capacity. The pumps shall provide a minimum of 17 feet of vertical lift at sea level. Appropriately sized check valves with fuel strainers shall be provided on the pump fuel inlets. The lead pump shall be sized to accommodate the motor and be supplied as:
    - .1 Two (2) - 7.6 LPM (2 USGPM) pumps with  $\frac{1}{3}$  HP, 115 VAC, 1 phase, 60 Hz, thermally protected motors.
    - .2 One (1) return pump system shall be supplied. The return pump operation shall be designed for automatic unattended operation when the day tank level exceeds 110% of its normal capacity. The return pump shall be activated by a separate, critical high level switch. The return pump shall exceed the delivery capacity of the fuel supply to the fuel day tank. The ECM is hard-wired to override any other indications given by the controller.
- .13 Fuel Containment.
- .1 The fuel day tank shall include a welded steel containment basin to prevent escape of fuel in the event of a tank rupture, sized at a minimum of 150% of the tank capacity. The basin shall be primed and finish painted.
  - .2 Indoor containment basin: The basin shall consist of an open-top, welded heavy gauge steel structure. Leak detection switch shall be wired into the electronic
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control module (ECM). This will shut down the supply pump and motor in case of a fuel leak into the containment basin.

- .14 Acceptable Products: Tramont TRS; Klein Corp.

### **2.3 ANTI-SIPHON VALVE**

- .1 Automatic shut-off to prevent spillage in the event of line rupture, cast or ductile iron body, adjustable hydrostatic pressure, brass trim, corrosion-resistant steel spring, fluorocarbon seal, sized for application, and built-in thermal expansion pressure relief valve.
- .2 Installed at fuel supply from day tank to motor.

### **2.4 FILL SIGNAL DEVICE**

- .1 Vent whistle and whistles when tank is being filled and stops whistling when tank is full, install on vent pipe at tank.

### **2.5 METALLIC PIPING, VALVES, AND FITTINGS**

- .1 In accordance with Section 23 11 13 - Facility Fuel-Oil Piping.

## **PART 3 - EXECUTION**

### **3.1 INSTALLATION**

- .1 Install tank(s) and all piping, fittings, accessories, and associated systems in accordance with National Fire Code of Canada, CCME – “Code of Practice”, CSA B139 Standard (as applicable), provincial regulations, and manufacturer’s recommendations.
- .2 Position tank(s) using lifting lugs and hooks, and, where necessary, use spreader bars. Do not use chain in contact with tank walls.
- .3 Provide all registrations and permits as required by Provincial regulations.

### **3.2 FIELD QUALITY CONTROL**

- .1 Test tank(s) for leaks to requirements of authority having jurisdiction and in presence of authority having jurisdiction.
- .2 Commission in accordance with Section 01 91 00 - Commissioning - Mechanical and Electrical Installation.

### **3.3 TOUCH-UP**

- .1 Where coating is damaged, touch-up original coating material.
- .2 Shield capillary and tubing connections in heavy-duty 50 mm polyethylene pipe.

**END OF SECTION**

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