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DEPARTMENT OF NATIONAL DEFENCE
CANADIAN FORCES BASE TRENTON

SPECIFICATION

**TRE-Upg B052 (HGR 10) Fire Pumphouse
8 Wing Trenton, Ontario**

DND Project No: 500006750

THIS DOCUMENT CONTAINS A SECURITY REQUIREMENT

<u>Section</u>	<u>Title</u>	<u>Pages</u>
<u>Division 01 – General Requirements</u>		
01 11 00	SUMMARY OF WORK	4
01 14 00	WORK RESTRICTIONS.....	4
01 29 83	PAYMENT PROCEDURES FOR TESTING LABORATORY SERVICE	2
01 31 19	PROJECT MEETINGS.....	2
01 32 16.19	GANTT CHART	4
01 33 00	SUBMITTAL PROCEDURES	4
01 35 13.13	SPECIAL PROJECT PROCEDURES FOR AIRPORT FACILITIES	2
01 35 13.43	SPECIAL PROJECT PROCEDURES FOR CONTAMINATED SITES	12
01 35 15	INDUSTRIAL SECURITY CONTRACTOR	6
01 35 29.06	HEALTH AND SAFETY REQUIREMENTS	6
01 35 35	DND FIRE SAFETY REQUIREMENTS.....	6
01 35 43	ENVIRONMENTAL PROTECTION.....	33
01 35 43.01	ENVIRONMENTAL PROTECTION – SOIL MANAGEMENT	9
01 41 00.01	QUALITY MANAGEMENT SYSTEM.....	8
01 45 00	QUALITY CONTROL	3
01 51 00	TEMPORARY UTILITIES	2
01 52 00	CONSTRUCTION FACILITIES.....	4
01 56 00	TEMPORARY BARRIERS AND ENCLOSURES	2
01 61 00	COMMON PRODUCT REQUIREMENTS	5
01 74 11	CLEANING.....	2
01 74 19	WASTE MANAGEMENT AND DISPOSAL.....	3
01 77 00	CLOSEOUT PROCEDURES	2
01 78 00	CLOSEOUT SUBMITTALS	7
01 79 00	DEMONSTRATION AND TRAINING.....	2
01 91 13	GENERAL COMMISSIONING (CX) REQUIREMENTS.....	11
01 91 13.13	COMMISSIONING PLAN	10
<u>Division 02 – Existing Conditions</u>		
02 41 13	SELECTIVE SITE DEMOLITION	5
02 41 13.13	PAVING REMOVAL	2
<u>Division 03 – Concrete</u>		
03 10 00	CONCRETE FORMING AND ACCESSORIES	3
03 20 00	CONCRETE REINFORCING	4
03 30 00	CAST-IN-PLACE CONCRETE	5
03 35 00	CONCRETE FINISHING	3
<u>Division 07 – Thermal and Moisture Protection</u>		
07 14 13	HOT FLUID-APPLIED RUBBERIZED ASPHALT WATERPROOFING	6
07 92 00	SEALANTS	4
<u>Division 09 – Finishes</u>		
09 91 23	INTERIOR PAINTING	9
<u>Division 13 – Special Construction</u>		
13 34 19	METAL BUILDING SYSTEMS.....	7
<u>Division 14 – Conveying Equipment</u>		

14 63 00	OVERHEAD CRANE	5
<u>Section</u>	<u>Title</u>	<u>Pages</u>

Division 21 – Fire Suppression

21 05 00	COMMON WORK RESULTS FOR FIRE SUPPRESSION.....	5
21 13 13	WET PIPE FIRE PROTECTION SYSTEMS.....	12
21 30 00	FIRE PUMPS	9

Division 22 – Plumbing

22 05 00	COMMON WORK RESULTS FOR PLUMBING	4
22 05 15	PLUMBING SPECIALTIES AND ACCESSORIES	7
22 11 16	DOMESTIC WATER PIPING.....	7
22 13 16.1	SANITARY WASTE AND VENT PIPING	3

Division 23 – Heating, Ventilating and Air Conditioning

23 01 05	OPERATION AND MAINTENANCE OF HVAC SYSTEMS DURING CONSTRUCTION1	
23 05 00	COMMON WORK RESULTS FOR HVAC	4
23 05 13	COMMON MOTOR REQUIREMENTS FOR HVAC EQUIPMENT	4
23 05 15	COMMON INSTALLATION REQUIREMENTS FOR HVAC PIPEWORK	5
23 05 17	PIPE WELDING	4
23 05 19.13	THERMOMETERS AND PRESSURE GAUGES – PIPING SYSTEMS	3
23 05 23.01	VALVES – BRONZE	4
23 05 23.02	VALVES – CAST IRON	5
23 05 29	HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT	7
23 05 48	VIBRATION AND SEISMIC CONTROLS FOR HVAC.....	4
23 05 53	IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT	6
23 05 93	TESTING, ADJUSTING AND BALANCING FOR HVAC	4
23 07 13	DUCT INSULATION.....	5
23 11 13	FACILITY FUEL OIL PIPING	7
23 31 13.01	METAL DUCTS – LOW PRESSURE TO 500 PA	5
23 33 00	AIR DUCT ACCESSORIES.....	4
23 33 15	DAMPERS – OPERATING	3
23 34 23.13	PACKAGED ROOF AND WALL EXHAUSTERS	3
23 35 16	ENGINE EXHAUST SYSTEMS.....	3
23 37 20	LOUVRES, INTAKES AND VENTS	3
23 82 39.23	UNIT HEATERS – ELECTRIC	3
23 82 39.26	LIQUID HEATERS	2

Division 25 – Integrated Automation

25 01 11	EMCS START-UP, VERIFICATION AND COMMISSIONING	5
25 05 01	EMCS GENERAL REQUIREMENTS.....	7
25 05 02	EMCS SUBMITTALS AND REVIEW PROCESS.....	4
25 05 54	EMCS IDENTIFICATION	3
25 05 60	EMCS FIELD INSTALLATION.....	8
25 08 20	EMCS WARRANTY AND MAINTENANCE	4
25 30 01	EMCS BUILDING CONTROLLERS	7
25 30 02	EMCS FIELD CONTROL DEVICES	10

Division 26 – Electrical

26 05 00	COMMON WORK RESULTS FOR ELECTRICAL	12
26 05 20	WIRE AND BOX CONNECTORS (0 – 1000 V).....	1
26 05 21	WIRES AND CABLES (0 – 1000 V).....	4

26 05 28	GROUNDING – SECONDARY	3
<u>Section</u>	<u>Title</u>	<u>Pages</u>

Division 26 – Electrical – cont’d

26 05 29	FASTENINGS AND SUPPORTS	2
26 05 32	OUTLET BOXES, CONDUIT BOXES AND FITTINGS	3
26 05 34	CONDUITS, CONDUIT FASTENINGS AND CONDUIT FITTINGS	5
26 05 43.01	INSTALLATION OF CABLES IN TRENCHES AND IN DUCTS	2
26 12 16.01	DRY TYPE TRANSFORMERS UP TO 600 V.....	3
26 24 00	DISTRIBUTION EQUIPMENT – LOW VOLTAGE	8
26 27 26	WIRING DEVICES	4
26 42 00.01	TELETHERMICS - CATHODIC PROTECTION	7
26 50 01	L.E.D. LIGHTING	7
26 53 00	EXIT LIGHTS.....	1
26 57 01	TESTING REQUIREMENTS AND COMPONENT TESTING	8
26 57 02	SYSTEM TESTING.....	2
26 57 03	EQUIPMENT AND SYSTEMS DEMONSTRATION	2

Division 27 – Communications

27 10 10	STRUCTURED DATA CABLING	5

Division 28 – Electronic Safety and Security

28 31 02	MULTIPLEX FIRE ALARM SYSTEM.....	14

Division 31 – Earthwork

31 05 16	AGGREGATES FOR EARTHWORK	4
31 23 16.26	ROCK REMOVAL	2
31 23 33.01	EXCAVATING, TRENCHING AND BACKFILLING.....	10

Division 32 – Exterior Improvements

32 11 16.01	GRANULAR SUB-BASE	4
32 11 23	AGGREGATE BASE COURSES	4
32 12 16	ASPHALT PAVING	6
32 91 19.13	TOPSOIL PLACEMENT AND GRADING.....	2
32 92 23	SODDING	3

Division 33 – Utilities

33 14 16	SITE WATER UTILITY DISTRIBUTION PIPING	12
33 31 11	PUBLIC SANITARY SEWAGE GRAVITY PIPING	6
33 46 16	SUBDRAINAGE PIPING	3
33 65 73	CONCRETE ENCASED DUCTBANKS	7
33 65 76	DIRECT BURIED UNDERGROUND CABLE DUCTS.....	2

Part 1 GENERAL

1.1 WORK COVERED BY CONTRACT DOCUMENTS

- .1 Work of this Contract comprises the following items of work, as depicted in the Contract Documents.
 - .1 The project is located at 52 North Star Drive, Trenton, ON.
 - .2 Construction of a new fire pump building, including lighting, heating, ventilation, fire alarm, fire-protection, and normal power. The fire pump building will be a pre-engineered building. A pre-engineered building and associated lighting, heating, ventilation, fire alarm, fire protection and normal power will be required to be constructed to the requirements of divisions 13, 21, 22, 23, 25, 26, 27, 28 and drawings 200, 201, 202, 203, 206, 209, 210, 301, 302, 401, 402, 403, 404, 405, 406, 407, 501, 502, 503, 504, 505, 701 and 702.
 - .3 Provision of new fire water storage tank to NFPA 22 including heating, mixer, access, level sensors, insulation, and interconnection to pump building.
 - .4 Provision for new 4 Tonne electric driven/operated, overhead bridge crane to be installed inside new pre-engineered building, crane rails/connections to pre-engineered building to be designed by pre-eng building manufacturer.
 - .5 Provision of new water servicing, sanitary servicing, grading and drainage.
 - .6 Provision of new fire protection system of pumps to NFPA 20 including intake and discharge headers, test headers, valves, fire alarm connections.
 - .7 Provision of new electrical service, lighting, power, communications and fire alarm systems.
 - .8 Provision of controls system to relay system status and alarms to BAS and allow start/stop functions.
 - .9 Provision of underground connection to existing hangar fire protection water supply.
Provision of new comms duct bank to connect the existing Glycol Building (B667) to MH N31 (east of Building B526).
 - .10 Commissioning of the new equipment and works and provision of all close out documentation.
 - .11 Clean up of all work spaces.

1.2 CONTRACT METHOD

- .1 Construct Work under single stipulated price contract.
- .2 The new fire pump building will be a pre-engineered system including heating, ventilation, lighting, power, fire alarm, controls in accordance with the requirements of Divisions 21, 22, 23, 25, 26, 27, 28 and drawings 200, 201, 202, 203, 206, 209, 210, 301, 302, 410, 402, 403, 405, 406, 407, 501, 502, 503, 504, 505, 506, 701 and 702. This building will be engineered under a design-build subcontract within this stipulated price contract and the pre-engineered design will be submitted for review as a shop drawing before commencing fabrication.

1.3 SUBMITTALS

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

- .2 Submit Project construction progress schedule in accordance with Section 01 32 16.19 - Construction Progress Schedule - Bar (GANTT) Chart.
- .3 Sustainable Design Submittals:
 - .1 Construction Waste Management:
 - .1 Submit project Waste Management Plan highlighting recycling and salvage requirements
 - .2 Submit calculations on end-of-project recycling rates, salvage rates, and landfill rates demonstrating 50 % of construction wastes recycled or salvaged
- .4 Submit site-specific and Work Plan Health and Safety Plan in accordance with Section 01 35 29.06 - Health and Safety Requirements.

1.4 WORK SEQUENCE

- .1 Construct Work in phases to accommodate Owner's continued use of premises during construction.
- .2 Co-ordinate Progress Schedule and co-ordinate with Owner Occupancy during construction.
- .3 Required phases:
 - .1 Construction of new pump house building.
 - .2 Provision of shut off valve on Hangar 10 existing underfloor main fire water supply from existing pump house.
 - .3 Connection of new pump house to Hangar 10 underfloor main fire water supply.
 - .4 Isolate old fire pump building and commission new fire pump building.
 - .5 Cap water supply from old pump building when new pump building commissioning is complete.
- .4 Maintain fire access/control.
- .5 Protect workers and building occupant safety.

1.5 CONTRACTOR USE OF PREMISES

- .1 Limit use of premises for Work, for storage, and for access, to allow:
 - .1 Owner occupancy of Hangar 10. Work at overhead doors and central corridor exterior slab cutting to be coordinated with building operations.
 - .2 DND use of airfield and taxiway. Coordinate all excavation, material delivery, building construction with DCC Representative. Coordinate water main crossing of taxiway with DCC Representative.
- .2 Co-ordinate use of premises under direction of DCC Representative.
- .3 Obtain and pay for use of additional storage or work areas needed for operations under this Contract.

- .4 Refer to Section 01 51 00 - Temporary Utilities, Section 01 52 00 - Construction Facilities and Section 01 56 00 - Temporary Barriers and Enclosures, for temporary facilities, access roads and parking areas, traffic regulations, and utilities.
- .5 Remove or alter existing work to prevent injury or damage to portions of existing work which remain.
- .6 Repair or replace portions of existing work which have been altered during construction operations to match existing or adjoining work, as directed by DCC Representative.
- .7 Ensure that condition of existing work at completion are still the same, equal to or better than that which existed before new work started.

1.6 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.

1.7 ALTERATIONS, ADDITIONS OR REPAIRS TO EXISTING BUILDING

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

1.8 EXISTING SERVICES

- .1 Notify, DCC 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 DCC 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 pedestrian vehicular traffic and tenant operations.
- .3 Provide alternative routes for personnel pedestrian and vehicular traffic.
- .4 Establish location and extent of service lines in area of work before starting Work. Notify DCC Representative of findings.
- .5 Submit schedule for approval by DCC 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.
- .6 Provide temporary services when directed by DCC Representative to maintain critical building and tenant services.
- .7 Provide adequate bridging over trenches which cross sidewalks or roads to permit normal traffic.
- .8 Where unknown services are encountered, immediately advise DCC Representative and confirm findings in writing.

- .9 Protect, relocate or maintain existing active services. When inactive services are encountered, cap off in manner approved by authorities having jurisdiction.
- .10 Record locations of maintained, re-routed and abandoned service lines.
- .11 Construct barriers, as required, in accordance with Section 01 56 00 - Temporary Barriers and Enclosures.

1.9 DOCUMENTS REQUIRED

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

Part 2 PRODUCTS

2.1 NOT USED

- .1 Not used.

Part 3 EXECUTION

3.1 NOT USED

- .1 Not used.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

- .1 Section 01 32 16.19 – Construction Project Schedules (GANTT) Chart
- .2 Section 01 35 15 – Industrial Security
- .3 Section 01 56 00 - Temporary Barriers and Enclosures

1.2 ACCESS AND EGRESS

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

1.3 USE OF SITE AND FACILITIES

- .1 Execute work with least possible interference or disturbance to normal use of premises. Make arrangements with DCC 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 Carry out work during regular work hours Monday to Friday from 0700 to 1530 hours. Contractor to make allowances for after hours work as required.
- .5 Closures: Protect work temporarily until permanent enclosures are completed.

1.4 ALTERATIONS, ADDITIONS OR REPAIRS TO EXISTING BUILDING

- .1 Execute work with least possible interference or disturbance to occupants and normal use of premises. Arrange with DCC Representative to facilitate execution of work.

1.5 CONTRACTOR USE OF PREMISES

- .1 Coordinate use of premises under direction of DCC Representative.
- .2 Obtain and pay for use of additional storage or work areas needed for operations under this Contract.

1.6 OWNER OCCUPANCY

- .1 Owner will occupy the First Floor of Hangar 1 and the Lunch Room 2122, Room 2119, and Locker Rooms 2109-2112 in the Middle section of the Second Floor during the entire construction period for execution of normal operations.
- .2 Cooperate with Owner in scheduling operations to minimize conflict and to facilitate Owner usage. Contractor to make allowances for after hours work as required.

- .3 Notify DCC Representative in writing and obtain DCC Representative approval in writing before the following events in and adjacent to Owner-occupied areas. Allow minimum two weeks for DCC and DND review and approval to proceed for each of the following events:
 - .1 Activities adjacent to the taxiways (within 48m of taxiway F and 91m of taxiway Papa) with a duration longer than one hour such as excavating and installing the new watermain near and across the taxiways,
 - .2 Activities inside the Hangar 10 main corridor with a duration longer than 4 hours such as cutting the floor slab inside Hangar 10, and
 - .3 Activities involving interruption to life safety systems such as interrupting the Hangar 10 sprinkler system operation for water pipe tie-ins and final testing.

1.7 EXISTING SERVICES

- .1 Notify DCC Site 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 DCC Site Representative 10 business days for necessary interruption of mechanical or electrical service throughout course of work. Minimize duration of interruptions. Carry out work at times as directed by governing authorities with minimum disturbance to tenant operations.
- .3 Conduct DND RP Ops work permit. Identify and locate all existing utility services present on construction site before starting work.
- .4 Submit schedule to and obtain approval from DCC 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 DCC Representative to maintain critical building and tenant systems.

1.8 SPECIAL REQUIREMENTS

- .1 Deliver materials during hours 0700 to 1530 as approved by DCC Representative.
- .2 Smoking is NOT permitted on premises.
- .3 Area of work is on an active air base. Do not disrupt airport business except as permitted by DCC Representative.
- .4 Obtain permission to use cranes on site. Any work using cranes must adhere to the 8 Wing crane policy.

1.9 CONTROL OF FOREIGN OBJECT DAMAGE (FOD)

- .1 Since the designated laydown area is adjacent to active airfield areas, the control of debris that causes FOD is critical.
- .2 The Contractor shall be responsible to keep this area clear of dirt and debris at all times. Inspect the area regularly and remove any debris found.

- .3 Failure to keep active areas free of debris to the satisfaction of the DCC & ATC Flight /OSS Representatives will result in shut-down of all construction activities until the situation is rectified.

1.10 FOD CONTROL PLAN

- .1 Foreign Object Damage (FOD) control procedures shall be enforced by the DCC Representative at all times in the construction and adjacent operational area(s). Keeping active runways, taxiways and aprons adjacent to the work clean during the Work shall be the responsibility of the Contractor.
- .2 The contractor shall submit a FOD Control Plan (FCP) to the DCC Representative for approval at least 14 calendar days prior to the start of work on-site. On-site work cannot start until the FCP is approved.
 - .1 The purpose of the Contractor's FCP is to assist the Contractor in demonstrating to the DCC Representative they have understood their responsibilities in managing FOD related issues throughout the project.
 - .2 The FCP shall address all aspects of how the Contractor will manage FOD control during the project, including which equipment they will be using and who will be the Contractor's designated person in charge of FOD control.
- .3 Site FOD sweeps shall be conducted as needed and when directed by the DCC Representative.

1.11 RESTRICTED OR SECURE AREA

- .1 Any area to which access is restricted by sign and/or monitored is a secure or restricted area.
- .2 Be responsible for construction personnel and vehicles employed on project and requiring access to restricted areas.

1.12 EVACUATION

- .1 The Contractor shall be required to abandon and evacuate the work site as directed, should an emergency situation be declared by DND.

Part 2 Products

2.1 NOT USED

- .1 Not Used.

Part 3 Execution

3.1 NOT USED

- .1 Not Used.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS SPECIFIED ELSEWHERE

- .1 Particular requirements for inspection and testing to be carried out by testing laboratory designated by DCC Representative are specified under various sections.

1.2 APPOINTMENT AND PAYMENT

- .1 DCC Representative will appoint and pay for services of testing laboratory except as follows:
 - .1 Inspection and testing required by laws, ordinances, rules, regulations or orders of public authorities.
 - .2 Testing, adjusting and balancing of mechanical and electrical equipment and systems.
 - .3 Inspection and testing performed exclusively for Contractor's convenience.
 - .4 Mill tests and certificates of compliance.
 - .5 Compaction Testing
 - .6 Construction Dewatering Testing
 - .7 Tests specified to be carried out by Contractor under the supervision of DCC Representative.
- .2 Where tests or inspections by designated testing laboratory reveal Work not in accordance with contract requirements, pay costs for additional tests or inspections as required by DCC Representative to verify acceptability of corrected work.

1.3 CONTRACTOR'S RESPONSIBILITIES

- .1 Provide labour, equipment and facilities to:
 - .1 Provide access to Work to be inspected and tested.
 - .2 Facilitate inspections and tests.
 - .3 Make good Work disturbed by inspection and test.
 - .4 Provide storage on site for laboratory's exclusive use to store equipment and cure test samples.
- .2 Notify DCC Representative sufficiently in advance of operations to allow for assignment of laboratory personnel and scheduling of test.
- .3 Where materials are specified to be tested, deliver representative samples in required quantity to testing laboratory.
- .4 Pay costs for uncovering and making good Work that is covered before required inspection or testing is completed and approved by DCC Representative.

Part 2 Products

2.1 NOT USED

- .1 Not used.

Part 3 Execution

3.1 NOT USED

.1 Not used.

END OF SECTION

Part 1 General

1.1 ADMINISTRATIVE

- .1 DCC Representative will schedule and administer project meetings throughout the progress of the work.
- .2 DCC Representative will prepare agenda for meetings.
- .3 Provide physical space and make arrangements for meetings.
- .4 DCC Representative will preside at meetings.
- .5 DCC Representative will record the meeting minutes. Significant proceedings and decisions will be included. Actions by parties will be identified.
- .6 DCC Representative will reproduce and distribute copies of minutes within 5 days after meetings and transmit to meeting participants and, affected parties not in attendance.
- .7 Representative of Contractor, Subcontractor and suppliers attending meetings will be

1.2 PRECONSTRUCTION MEETING

- .1 Within 15 days after award of Contract, DCC Representative will arrange a meeting of parties in contract to discuss and resolve administrative procedures and responsibilities.
- .2 Senior DCC Representatives, DCC Coordinator Construction Services, Contractor, major Subcontractors and Contractor's field inspectors and supervisors will be in attendance.
- .3 DCC Representative will establish time and location of meeting and notify parties concerned minimum 5 days before meeting.
- .4 Incorporate mutually agreed variations to Contract Documents into Agreement, prior to signing.
- .5 Agenda to include:
 - .1 Appointment of official representative of participants in the Work.
 - .2 Schedule of Work: in accordance with Section 01 32 16.19 - Construction Progress Schedule - Bar (GANTT) Chart.
 - .3 Schedule of submission of shop drawings, samples, colour chips. Submit submittals in accordance with Section 01 33 00 - Submittal Procedures.
 - .4 Requirements for temporary facilities, offices, storage sheds, utilities, fences in accordance with Section 01 52 00 - Construction Facilities.
 - .5 Delivery schedule of specified equipment.
 - .6 Site security in accordance with Section 01 56 00 - Temporary Barriers and Enclosures.
 - .7 Proposed changes, change orders, procedures, approvals required, mark-up percentages permitted, time extensions, overtime, administrative requirements.
 - .8 Record drawings in accordance with Section 01 33 00 - Submittal Procedures.
 - .9 Maintenance manuals in accordance with Section 01 78 00 - Closeout Submittals.
 - .10 Take-over procedures, acceptance, warranties in accordance with Section 01 78 00 - Closeout Submittals.
 - .11 Monthly progress claims, administrative procedures, photographs, hold backs.
 - .12 Appointment of inspection and testing agencies or firms.
 - .13 Insurances, transcript of policies.

1.3 PROGRESS MEETINGS

- .1 During course of Work and 2 weeks prior to project completion, progress meetings will be held every 14 days. Meetings may be held at shorter or longer intervals if the contractor and the DCC Representative are in agreement.
- .2 Contractor, major Subcontractors involved in Work and DCC Representative, are to be in attendance.
- .3 Parties will be notified a minimum of 5 days prior to meetings.
- .4 DCC Representative will record minutes of meetings and circulate to attending parties and affected parties not in attendance within 5 days after meeting.
- .5 Agenda to include the following:
 - .1 Review, approval of minutes of previous meeting.
 - .2 Review of Work progress since previous meeting.
 - .3 Field observations, problems, conflicts.
 - .4 Problems which impede construction schedule.
 - .5 Review of off-site fabrication delivery schedules.
 - .6 Corrective measures and procedures to regain projected schedule.
 - .7 Revision to construction schedule.
 - .8 Progress schedule, during succeeding work period.
 - .9 Review submittal schedules: expedite as required.
 - .10 Maintenance of quality standards and Contractor's Construction Quality Plan.
 - .11 Review proposed changes for affect on construction schedule and on completion date.
 - .12 Other business.

Part 2 PRODUCTS

2.1 NOT USED

- .1 Not Used.

Part 3 EXECUTION

3.1 NOT USED

- .1 Not Used.

END OF SECTION

Part 1 General

1.1 DEFINITIONS

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

1.2 REQUIREMENTS

- .1 Ensure Master Plan and Detail Schedules are practical and remain within specified Contract duration.
- .2 Plan to complete Work in accordance with prescribed milestones and time frame.
- .3 Limit activity durations to maximum of approximately 10 working days, to allow for progress reporting.
- .4 Ensure that it is understood that Award of Contract or time of beginning, rate of progress, Interim Certificate and Final Certificate as defined times of completion are of essence of this contract.

1.3 SUBMITTALS

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

- .2 Submit to DCC Representative within 5 working days of Award of Contract Bar (GANTT) Chart as Master Plan for planning, monitoring and reporting of project progress.
- .3 Submit Project Schedule to DCC Representative within 5 working days of receipt of acceptance of Master Plan.

1.4 PROJECT SCHEDULE REPORTING

- .1 Update Project Schedule on bi-weekly basis reflecting activity changes and completions, as well as activities in progress.
- .2 Include as part of Project Schedule, narrative report identifying Work status to date, comparing current progress to baseline, presenting current forecasts, defining problem areas, anticipated delays and impact with possible mitigation.
- .3 Include dates for commencement and completion of each major element of construction.
- .4 Show projected percentage of completion of each item as of the first day of month.
- .5 Indicate progress of each activity to date of submission schedule.
- .6 Show changes occurring since previous submissions of schedule:
 - .1 Major changes in scope
 - .2 Activities modified since previous submission
 - .3 Revised projections of progress and completion
 - .4 Other identifiable changes.
- .7 Provide a narrative report to define:
 - .1 Problem areas, anticipated delays and impact on schedule
 - .2 Corrective action recommended and its effect
 - .3 Effect of changes on schedules of other prime contractors

1.5 PROJECT MEETINGS

- .1 Discuss Project Schedule at regular site meetings, identify activities that are behind schedule and provide measures to regain slippage. Activities considered behind schedule are those with projected start or completion dates later than current approved dates shown on baseline schedule.
- .2 Weather related delays with their remedial measures will be discussed and negotiated.
- .3 Coordination Meetings
 - .1 Prior to commencement of construction work convene a meeting with affected trades, Project Manager and DCC Site Representative to review Contractor's proposed methodology for staging the construction, the removal of existing services and installation of new services.
 - .2 Prior to commencement of construction work and the preparation of interference drawings, convene a coordination meeting with all major trades, Project Manager and DCC Site Representative to review the integration of the building systems, their interrelationships, potential conflict areas and strategies for their resolution.

- .3 Convene a meeting with all trades to review the placement of all interior and exterior devices, sensors, switches and other similar items to plan a coordinated approach to arranging these items.

1.6 PROJECT MILESTONES

- .1 Project milestones form interim targets for Project Schedule.
 - .1 Award of Contract.
 - .2 Site Mobilization completed.
 - .3 Demolition completed.
 - .4 Excavation completed.
 - .5 Substructure completed.
 - .6 Envelope completed.
 - .7 Civil works completed.
 - .8 Finishing and fitting, Mechanical, and Electrical work completed.
 - .9 Interim Certificate (Substantial Completion).

1.7 MASTER PLAN

- .1 Structure schedule to allow orderly planning, organizing and execution of Work as Bar Chart (GANTT).
- .2 DCC Representative will review and return revised schedules within 5 working days.
- .3 Revise impractical schedule and resubmit within 5 working days.
- .4 Accepted revised schedule will become Master Plan and be used as baseline for updates.

1.8 PROJECT SCHEDULE

- .1 Develop detailed Project Schedule derived from Master Plan.
- .2 Ensure detailed Project Schedule includes as a minimum milestone and activity types as follows:
 - .1 Award.
 - .2 Shop Drawings, Samples.
 - .3 Permits.
 - .4 Mobilization.
 - .5 Excavation.
 - .6 Backfill.
 - .7 Structural Steel.
 - .8 Siding and Roofing.
 - .9 Plumbing.
 - .10 Electrical.
 - .11 Controls.
 - .12 Testing and Commissioning.
 - .13 Supplied equipment long delivery items.

- .14 Engineer supplied equipment required dates.
- .3 Prepare schedule in MS Project and submit in MS Project and pdf format.

Part 2 Products

2.1 NOT USED

- .1 Not Used.

Part 3 Execution

3.1 NOT USED

- .1 Not Used.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

- .1 Section 01 32 16.19 – Construction Progress Schedules – Bar (GANTT) Chart.
- .2 Section 01 45 00 – Quality Control.
- .3 Section 01 77 00 – Closeout Submittals.

1.2 ADMINISTRATIVE

- .1 Submit DCC 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 DCC Representative. This review represents that necessary requirements have been determined and verified, or will be, and that each submittal has been checked and coordinated with requirements of Work and Contract Documents. Submittals not stamped, signed, dated and identified as to specific project will be returned without being examined and considered rejected.
- .6 Notify DCC Representative, in writing at time of submission, identifying deviations from requirements of Contract Documents stating reasons for deviations.
- .7 Verify field measurements and affected adjacent Work are coordinated.
- .8 Contractor's responsibility for errors and omissions in submission is not relieved by DCC Representative's review of submittals.
- .9 Contractor's responsibility for deviations in submission from requirements of Contract Documents is not relieved by DCC 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.
- .2 Indicate materials, methods of construction and attachment or anchorage, erection diagrams, connections, explanatory notes and other information necessary for completion of Work. Where articles or equipment attach or connect to other articles or equipment, indicate that such items have

- been coordinated, regardless of Section under which adjacent items will be supplied and installed. Indicate cross references to design drawings and specifications.
- .3 Allow 10 business days for DCC Representative's review of each submission.
 - .4 Adjustments made on shop drawings by DCC Representative are not intended to change Contract Price. If adjustments affect value of Work, state such in writing to DCC Representative prior to proceeding with Work.
 - .5 Make changes in shop drawings as DCC Representative may require, consistent with Contract Documents. When resubmitting, notify DCC Representative in writing of revisions other than those requested.
 - .6 Accompany submissions with transmittal letter, in duplicate, containing:
 - .1 Date.
 - .2 Project title and number.
 - .3 Contractor's name and address.
 - .4 Identification and quantity of each shop drawing, product data and sample
 - .5 Other pertinent data.
 - .7 Submissions include:
 - .1 Date and revision dates.
 - .2 Project title and number.
 - .3 Name and address of:
 - .1 Subcontractor.
 - .2 Supplier.
 - .3 Manufacturer.
 - .4 Contractor's stamp, signed by Contractor's authorized representative certifying approval of submissions, verification of field measurements and compliance with Contract Documents.
 - .5 Details of appropriate portions of Work as applicable:
 - .1 Fabrication.
 - .2 Layout, showing dimensions, including identified field dimensions, and clearances.
 - .3 Setting or erection details.
 - .4 Capacities.
 - .5 Performance characteristics.
 - .6 Standards.
 - .7 Operating weight.
 - .8 Wiring diagrams.
 - .9 Single line and schematic diagrams.
 - .10 Relationship to adjacent work
 - .8 After DCC Representative's review, distribute copies.
 - .9 Submit electronic copies of shop drawings for each requirement requested in specification Sections.

- .10 Delete information not applicable to project.
- .11 Supplement standard information to provide details applicable to project.
- .12 If upon review by DCC 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.
- .13 Where required in specific Sections submit drawings stamped and signed by professional engineer registered or licensed in Ontario, Canada.
- .14 Indicate specific product selections where product data provides multiple choices.

1.4 SAMPLES

- .1 Submit for review samples as requested in respective specification Sections. Label samples with origin and intended use.
- .2 Deliver samples prepaid to DCC Representative's site office.
- .3 Notify DCC 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 DCC Representative are not intended to change Contract Price. If adjustments affect value of Work, state such in writing to DND Representative prior to proceeding with Work.
- .6 Make changes in samples which DND 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.

Part 2 Products

2.1 NOT USED

- .1 Not Used.

Part 3 Execution

3.1 NOT USED

- .1 Not Used.

END OF SECTION

Part 1 GENERAL

1.1 GENERAL PROTECTION

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

1.2 MOVEMENT OF EQUIPMENT AND PERSONNEL

- .1 In areas of airport not closed to aircraft traffic:
 - .1 Obtain DCC Representative's approval on scheduling of Work.
 - .2 Control movements of equipment and personnel as directed by DCC Representative.
 - .3 Provide qualified field personnel at locations designated by DCC Representative to relay signals from airport traffic control tower to equipment and personnel wishing to cross live traffic areas.
 - .4 Immediately obey signals from airport traffic control tower.

1.3 UNSERVICEABLE AREAS

- .1 Mark off areas made unserviceable for aircraft by Work of this Contract by providing highly visible danger markings by day and red lights by night.
- .2 Open flames and flammable fuels are not permitted.
- .3 Park equipment not in use and stockpile materials so that stockpile tops are below 50 to 1 ratio from ends of useable landing strip and below 20 to 1 ratio from sides of aircraft traffic areas.
 - .1 Mark tops with red lights as directed by DCC Representative.

1.4 TRENCHING

- .1 Obtain DCC Representative's written permission to undertake trenching on pavements open to aircraft traffic which cannot be completed, backfilled and sealed within 1 working day.

1.5 AIRPORT FACILITIES

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

Part 2 PRODUCTS

2.1 NOT USED

.1 Not Used.

Part 3 EXECUTION

3.1 NOT USED

.1 Not Used.

END OF SECTION

Part 1 GENERAL

1.1 REFERENCE STANDARDS

- .1 Department of Justice Canada (Jus)
 - .1 SOR/2018-196 Prohibition of Asbestos and Products Containing Asbestos Regulations.
- .2 Canadian General Standards Board (CGSB)
 - .1 CGSB 51-GP-51M-81, Polyethylene Sheet for Use in Building Construction.
- .3 Transportation and Dangerous Goods Act (1999)
- .4 Canadian Council of Ministers of the Environment (CCME) Documentation

1.2 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submittals: in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Submit, prior to start of work, plan detailing management of hazardous wastes. Submit written documentation of weekly hazardous waste inspections on a quarterly basis.
- .3 Submittals for Progress Meetings: make submittals at least 24 hours prior to scheduled progress meetings as follows:
 - .1 Updated progress schedule detailing activities. Include review of progress with respect to previously established dates for starting and stopping various stages of Work, major problems and action taken, injury reports, equipment breakdown, and material removal.
 - .2 Copies of air sampling results.
 - .3 Copies of transport manifests, trip tickets, and disposal receipts for waste materials removed from work area.
 - .4 Weekly copies of site entry and work area logbooks with information on worker and visitor access.
 - .5 Weekly logs documenting filter changes on HEPA vacuums, and other engineering controls.
 - .6 Weekly results of collected air sampling data, including compliance air monitoring results.
 - .7 Other information required by DCC Representative or relevant to agenda for upcoming progress meeting.
- .4 Site Layout: within 7 days after date of Notice to Proceed and prior to mobilization to site, submit site layout drawings showing existing conditions and facilities, construction facilities and temporary controls provided by Contractor including following:
 - .1 Drum sampling and staging areas, Tank dismantling areas.
 - .2 Equipment and personnel decontamination areas.
 - .3 Means of ingress, egress and temporary traffic control facilities. Refer to Section 01 56 00 - Temporary Barriers and Enclosures for traffic control.
 - .4 Equipment and material staging areas.

- .5 Soil stockpile areas, Demolition debris stockpile areas.
- .6 Exclusion Zones, Contaminant Reduction Zones, and other zones specified in Contractor's site-specific Health and Safety Plan.
- .7 Grading, including contours, required to construct temporary facilities.
- .8 Wastewater treatment facilities or Wastewater storage tank areas.
- .5 Equipment Decontamination Pad: submit equipment decontamination pad design to DCC Representative for review prior to commencing construction.
- .6 Submit documentation verifying that hazardous materials employees have been trained, tested, and certified to safely and effectively carry out their assigned duties in accordance with Section 01 35 29.06 – Health and Safety.

1.3 REGULATORY REQUIREMENTS

- .1 Provide erosion and sediment control in accordance with Federal regulations.
- .2 Comply with federal, provincial, and local anti-pollution laws, ordinances, codes, and regulations when disposing of waste materials, debris, and rubbish.
- .3 Work to meet or exceed minimum requirements established by federal, provincial, and local laws and regulations which are applicable.
 - .1 Contractor: responsible for complying with amendments as they become effective.
- .4 In event that compliance exceeds scope of work or conflicts with specific requirements of contract notify DCC Representative immediately.

1.4 SEQUENCING AND SCHEDULING

- .1 Do not commence Work involving contact with potentially contaminated materials until decontamination facilities are operational and approved by DCC Representative.

1.5 EQUIPMENT DECONTAMINATION FACILITY

- .1 Prior to commencing work involving equipment contact with potentially contaminated materials, construct equipment decontamination pad to accommodate largest piece of on-site potentially contaminated equipment.
- .2 Provide, operate, and maintain suitable portable, high-pressure, low-volume decontamination wash units equipped with self-contained water storage tank and pressurizing system and capable of heating and maintaining wash waters to 80 degrees C and providing nozzle pressure of 1,035 kpa.
- .3 Provide, operate, and maintain necessary equipment, pumps, and piping required to collect and contain equipment decontamination wastewater and sediment and transfer materials to approved storage facilities.

1.6 DRUM STAGING PAD

- .1 Provide, maintain, and operate drum staging pad as required.

- .2 Construct drum staging pad with sump capable of collecting leachate and rain runoff. Place polyethylene sheeting such that sheeting contours over top of berm, and leachate and runoff from staging pad is directed solely to sump on staging pad.

1.7 SOIL STOCKPILING FACILITIES

- .1 Provide, maintain, and operate storage/stockpiling facilities as required.
- .2 Install liner below proposed stockpile locations to prevent contact between stockpile material and ground. Equip facility with tarps capable of covering stockpiled material until DCC Representative advises Contractor to dispose of material off site.

1.8 DESIGN REQUIREMENTS

- .1 Water Treatment Facility:
 - .1 Design and Operating Criteria: design water filtering plant capable of filtering water generated from dewatering excavations and work areas to meet discharge requirements of authority having jurisdiction, capable of removing oil, suspended solids, particulates, and asbestos fibers, and filter water through 5-micron particulate filter prior to discharge.
 - .2 Ensure that discharges from site are in compliance with applicable permit requirements and limitations.
 - .3 Provide piping to transfer liquid/solid mixtures generated by dewatering operations which require water filtering to water filtering plant.
 - .4 Design water filtering operations capable of receiving liquid/solid mixtures and not causing delay to dewatering operations.
- .2 Piping: suitable material type, of sufficient diameter and structural thickness for purpose intended; satisfactorily tested for leaks with potable water in presence of DCC Representative before handling wastewater.
- .3 Installation:
 - .1 Provide labour, materials, and equipment and do work required for setup and construction of water filtering plant.
 - .2 Cut vegetation to ground level.
 - .3 Install component systems in accordance with installation procedures and as indicated.
 - .4 Following installation of system, implement initial operation test in accordance with procedures developed by Contractor and submitted to DCC Representative for review.
 - .5 Install piping in accordance with manufacturer's instructions and test for leakage using potable water prior to commencing dewatering and filtering operations.
- .4 Initial Testing: performance of water filtering plant provided by Contractor will initially be determined by DCC Representative as follows:
- .5 Operation:
 - .1 On basis of analytical results obtained by DCC Representative, make system modifications required for effluent to satisfy effluent criteria, or continue with normal dewatering operations as directed by DCC Representative.

- .2 Operate water filtering plant by experienced, qualified personnel in accordance with manufacturer's instructions and procedures submitted by Contractor and approved by DCC Representative.
- .6 Decommissioning/Dismantling:
 - .1 Decontaminate and remove salvageable components of water filtering plant including water filtering system, pumps, piping, and electrical equipment.
 - .2 Dispose of non-salvageable equipment and materials at approved off-site disposal facility.

1.9 WASTEWATER STORAGE TANK

- .1 Provide, operate, and maintain wastewater storage tanks to store wastewaters.
- .2 Wastewater includes handbasin, shower, and laundry wastewaters from Personnel Hygiene/Decontamination Facility; water collected from dewatering operations; and water collected from Equipment Decontamination Facility.
- .3 Store wastewaters from dewatering operations and Equipment Decontamination Facility in separate tank from wastewater from Personnel Hygiene/Decontamination Facility.
- .4 If toilet facilities are provided in Personnel Hygiene/Decontamination Facility, store wastewater from these toilets with wastewater from handbasins, showers, and laundry for ultimate disposal off site.
- .5 Discharges: comply with applicable discharge limitations and requirements; do not discharge wastewaters to site sewer systems that do not conform to or are in violation of such limitations or requirements; and obtain DCC Representative's approval prior to discharge of wastewater.
- .6 Provide pumps and piping to convey collected wastewaters to designated wastewater storage tanks; provide wastewater storage tanks with minimum total live capacity such that effluent quality can be analyzed and approved prior to discharge to sanitary sewer system.
- .7 Install wastewater storage tanks in locations as directed by DCC Representative.
- .8 Support tanks on temporary aboveground foundations.
- .9 Connect pumps, piping, valves, miscellaneous items, and necessary utilities as required for operation of facilities; and protect tanks, valves, pumps, piping, and miscellaneous items from freezing.
- .10 Do not operate wastewater storage tanks until inspected and approved by DCC Representative.
- .11 Notify DCC Representative 72 hours minimum in advance of when wastewater storage tank is anticipated to be full.
 - .1 Do not discharge additional liquids to filled tank following sampling by DCC Representative.
 - .2 DCC Representative will determine appropriate disposition of wastewaters based on sample analysis.

- .12 Transport and dispose of wastewaters at off-site disposal facility as identified by Contractor and approved by DCC Representative.
- .13 Contractor to pay for transporting and disposing of wastewater to off-site disposal facility.

1.10 DRUMS

- .1 Storage of Liquid Waste: 200 L steel drums meeting Transportation and Dangerous Goods Act, closable lids, complete with labels for marking contents and date filled.
- .2 Storage of Solid Waste: 200 L steel drums meeting Transportation and Dangerous Goods Act, closable lids, complete with labels for marking contents and date filled.

1.11 VEHICULAR ACCESS AND PARKING

- .1 Maintenance and Use:
 - .1 Prevent contamination of access roads. Immediately scrape up debris or material on access roads which is suspected to be contaminated as determined by DCC Representative; transport and dispose of in appropriate off-site disposal facility. Clean access roads at least once per shift.
 - .2 DCC Representative may collect soil samples for chemical analyses from traveling surfaces of constructed and existing access routes prior to, during, and upon completion of Work. Excavate and dispose of clean soil contaminated by Contractor's activities at no additional cost to DCC Representative.

1.12 DUST AND PARTICULATE CONTROL

- .1 Execute Work by methods to minimize raising dust from construction operations.
- .2 Implement and maintain dust and particulate control measures immediately during construction and in accordance with Province of Ontario regulations.
- .3 Provide positive means to prevent airborne dust from dispersing into atmosphere. Use potable water for water misting system for dust and particulate control.
- .4 Use chemical means for water misting system for dust and particulate control only with DCC Representative's prior written approval.
- .5 As minimum, use appropriate covers on trucks hauling fine or dusty material. Use watertight vehicles to haul wet materials.
- .6 Prevent dust from spreading to adjacent property sites.
- .7 DCC Representative will stop work at any time when Contractor's control of dusts and particulates is inadequate for wind conditions present at site, or when air quality monitoring indicates that release of fugitive dusts and particulates into atmosphere equals or exceeds specified levels.
- .8 If Contractor's dust and particulate control is not sufficient for controlling dusts and particulates into atmosphere, stop work. Contractor must discuss procedures that Contractor proposes to

resolve problem. Make necessary changes to operations prior to resuming excavation, handling, processing, or other work that may cause release of dusts or particulates.

1.13 POLLUTION CONTROL

- .1 Provide methods, means, and facilities to prevent contamination of soil, water, and atmosphere from discharge of noxious toxic substances and pollutants produced by construction operations.
- .2 Be prepared to intercept, clean up, and dispose of spills or releases that may occur whether on land or water. Maintain materials and equipment required for cleanup of spills or releases readily accessible on site.
- .3 Promptly report spills and releases potentially causing damage to environment to:
 - .1 Authority having jurisdiction or interest in spill or release including conservation authority, water supply authorities, drainage authority, road authority, and fire department.
 - .2 Owner of pollutant, if known.
 - .3 Person having control over pollutant, if known.
 - .4 DCC Representative.
- .4 Contact manufacturer of pollutant if known and ascertain hazards involved, precautions required, and measures used in cleanup or mitigating action.
- .5 Take immediate action using available resources to contain and mitigate effects on environment and persons from spill or release.
- .6 Provide spill response materials including, containers, adsorbent, shovels, and personal protective equipment. Make spill response materials available at all times in which hazardous materials or wastes are being handled or transported. Spill response materials: compatible with type of material being handled.
- .7 Volatile Organic Compounds (VOC) Control:
 - .1 In addition to requirements of Section 01 35 29.06 – Health and Safety Requirements, monitor air quality for volatile organics at perimeter security fence locations as approved by DCC Representative, every hour during contaminated materials excavation and management activities, and maintain log of air quality readings.
 - .2 If air quality monitoring indicates that release of volatile organics in air at site boundary exceeds Level C of Personnel Protective Equipment threshold for air quality, implement corrective actions to control volatile organics.
 - .3 If actions are not sufficient to control release of volatile organics within 1/2 hour of identification of air quality problem, suspend work resulting in excessive volatile organic emissions. DCC Representative and Contractor to discuss additional methods that Contractor proposes to control release of volatile organics.
 - .4 Make necessary changes at no additional cost to DCC Representative prior to resuming Work.
 - .5 In addition, if DCC Representative's monitoring of ambient air at site perimeter indicates that concentration of contaminants in air exceed unacceptable concentrations of contaminants in air, modify operations to minimize such off-site impacts.

1.14 EQUIPMENT DECONTAMINATION

- .1 Commence Work involving equipment contact with potentially contaminated material only after Equipment Decontamination Facility is operational.
- .2 Decontaminate equipment after working in potentially contaminated work areas and prior to subsequent work or travel on clean areas.
- .3 Perform equipment decontamination on Contractor-constructed equipment decontamination pad.
- .4 At minimum, perform following steps during equipment decontamination: mechanically remove packed dirt, grit, and debris by scraping and brushing without using steam or high-pressure water to reduce amount of water needed and to reduce amount of contaminated rinsate generated. Use high-pressure, low-volume, hot water or steam supplemented by detergents or solvents as appropriate. Pay particular attention to tire treads, equipment tracks, springs, joints, sprockets, and undercarriages. Scrub surfaces with long handle scrub brushes and cleaning agent. Rinse off and collect cleaning agent. Air dry equipment in Clean Zone before removing from site or travelling on clean areas. Perform assessment as directed by DCC Representative to determine effectiveness of decontamination.
- .5 Maintain inspection record on site which includes: equipment descriptions with identification numbers or licence plates; time and date entering decontamination facility; time and date exiting decontamination facility; and name of inspector with comment stating that decontamination was performed and completed.
- .6 Each piece of equipment will be inspected by DCC Representative after decontamination and prior to removal from site and/or travel on clean areas. DCC Representative will have right to require additional decontamination to be completed if deemed necessary.
- .7 Take appropriate measures necessary to minimize drift of mist and spray during decontamination including provision of wind screens.
- .8 Collect decontamination wastewaters and sediments which accumulate on equipment decontamination pad. Transfer wastewaters to designated wastewater storage tank or drums.
- .9 Transfer sediments to soil staging area, drums or disposal transport vehicle.
- .10 Furnish and equip personnel engaged in equipment decontamination with protective equipment including suitable disposable clothing, respiratory protection, and face shields.
- .11 Have on hand sufficient pumping equipment, of adequate pumping capacity and associated machinery and piping in good working condition for ordinary emergencies, including power outage, and competent workers for operation of pumping equipment. Maintain piping and connections in good condition and leak-free.

1.15 WATER CONTROL

- .1 Maintain excavations free of water.
- .2 Protect site from puddling or running water. Grade site to drain. Provide water barriers as necessary to protect site from soil erosion.

- .3 Prevent surface water runoff from leaving work areas.
- .4 Do not discharge decontaminated water, or surface water runoff, or groundwater which may have come in contact with potentially contaminated material, off site or to municipal sewers.
- .5 Prevent precipitation from infiltrating or from directly running off stockpiled waste materials. Cover stockpiled waste materials with an impermeable liner during periods of work stoppage including at end of each working day and as directed by DCC Representative.
- .6 Direct surface waters that have not contacted potentially contaminated materials to existing surface drainage systems.
- .7 Control surface drainage including ensuring that gutters are kept open, water is not directed across or over pavements or sidewalks except through approved pipes or properly constructed troughs, and runoff from unstabilized areas is intercepted and diverted to suitable outlet.
- .8 Dispose of water in manner not injurious to public health or safety, to property, or to any part of Work completed or under construction.
- .9 Provide, operate, and maintain necessary equipment appropriately sized to keep excavations, staging pads, and other work areas free from water.
- .10 Contain water from stockpiled waste materials. Transfer potentially contaminated surface waters to wastewater storage tanks separate from wastewater from Personnel Hygiene/Decontamination Facility.
- .11 Have on hand sufficient pumping equipment, machinery, and tankage in good working condition for ordinary emergencies, including power outage, and competent workers for operation of pumping equipment.
- .12 Contain and collect wastewaters and transfer such collected wastewaters to Contractor -supplied drums, wastewater storage tanks or on-site treatment facility.

1.16 DEWATERING

- .1 Dewater various parts of Work including, without limitation, excavations, structures, foundations, and work areas.
- .2 Employ construction methods, plant procedures, and precautions that ensure Work, including excavations, are stable, free from disturbance, and dry.
- .3 Dewatering Methods: includes sheeting and shoring; groundwater control systems; surface or free water control systems employing ditches, diversions, drains, pipes and/or pumps; and other measures necessary to enable Work to be carried out in dry conditions.
- .4 Provide sufficient and appropriate labour, plant, and equipment necessary to keep Work free of water including standby equipment necessary to ensure continuous operation of dewatering system.
- .5 Take precautions necessary to prevent uplift of structure or pipeline and to protect excavations from flooding and damage due to surface runoff.

- .6 Test and analyse water generated from dewatering activities and treat to meet required discharge or disposal criteria.

1.17 EROSION AND SEDIMENT CONTROL

- .1 Plan and execute construction by methods to control surface drainage from cuts and fills, from borrow and waste disposal areas, from stockpiles, staging areas, and other work areas. Prevent erosion and sedimentation.
- .2 Minimize amount of bare soil exposed at one time. Stabilize disturbed soils as quickly as practical. Strip vegetation, regrade, or otherwise develop to minimize erosion. Remove accumulated sediment resulting from construction activity from adjoining surfaces, drainage systems, and water courses, and repair damage caused by soil erosion and sedimentation as directed by DCC Representative.
- .3 Provide and maintain temporary measures which may include, silt fences, hay or straw bales, ditches, geotextiles, drains, berms, terracing, riprap, temporary drainage piping, sedimentation basins, vegetative cover, dikes, and other construction required to prevent erosion and migration of silt, mud, sediment, and other debris off site or to other areas of site where damage might result, or that might otherwise be required by Laws and Regulations. Make sediment control measures available during construction. Place silt fences and/or hay or straw bales in ditches to prevent sediments from escaping from ditch terminations.
- .4 Hay or Straw Bale: wire bound or string tied; securely anchored by at least 2 stakes or rebars driven through bale 300 mm to 450 mm into ground; chinked (filled by wedging) with hay or straw to prevent water from escaping between bales; and entrenched minimum of 100 mm into ground.
- .5 Silt Fence: assembled, ready to install unit consisting of geotextile attached to driveable posts. Geotextile: uniform in texture and appearance, having no defects, flaws, or tears that would affect its physical properties; and contain sufficient ultraviolet ray inhibitor and stabilizers to provide minimum 2-year service life from outdoor exposure.
- .6 Net Backing: industrial polypropylene mesh joined to geotextile at both top and bottom with double stitching of heavy-duty cord, with minimum width of 750 mm.
- .7 Posts: sharpened wood, approximately 50 mm square, protruding below bottom of geotextile to allow minimum 450 mm embedment; post spacing 2.4 m maximum. Securely fasten each post to geotextile and net backing using suitable staples.
- .8 Plan construction procedures to avoid damage to work or equipment encroachment onto water bodies or drainage ditch banks. In event of damage, promptly take action to mitigate effects. Restore affected bank or water body to existing condition.
- .9 Installation:
 - .1 Construct temporary erosion control items as indicated. Actual alignment and/or location of various items as directed by DCC Representative.
 - .2 Do not construct bale barriers and silt fence in flowing streams or in swales.
 - .3 Check erosion and sediment control measures weekly after each rainfall; during prolonged rainfall check daily.

- .4 Bales and/or silt fence may be removed at beginning of work day, replace at end of work day.
- .5 Whenever sedimentation is caused by stripping vegetation, regrading, or other development, remove it from adjoining surfaces, drainage systems, and watercourses, and repair damage as quickly as possible.
- .6 Prior to or during construction, DCC Representative may require installation or construction of improvements to prevent or correct temporary conditions on site. Improvements may include berms, mulching, sediment traps, detention and retention basins, grading, planting, retaining walls, culverts, pipes, guardrails, temporary roads, and other measures appropriate to specific condition. Temporary improvements must remain in place and in operation as necessary or until otherwise directed by DCC Representative.
- .7 Repair damaged bales, end runs, and undercutting beneath bales.
- .8 Unless directed by DCC Representative, remove temporary erosion and sediment control devices upon completion of Work. Spread accumulated sediments to form a suitable surface for seeding or dispose of, and shape area to permit natural drainage to satisfaction of DCC Representative. Materials once removed become property of Contractor.
- .10 Construct fill and waste areas by selective placement to avoid erosive surface silts or clays.
- .11 Do not disturb existing embankments or embankment protection.
- .12 Periodically inspect earthwork to detect evidence of erosion and sedimentation; promptly apply corrective measures.
- .13 If soil and debris from site accumulate in low areas, storm sewers, roadways, gutters, ditches, or other areas where in DCC Representative's determination it is undesirable, remove accumulation and restore area to original condition.

1.18 PROGRESS CLEANING

- .1 Maintain cleanliness of Work and surrounding site to comply with federal, provincial, and local fire and safety laws, ordinances, codes, and regulations.
- .2 Co-ordinate cleaning operations with disposal operations to prevent accumulation of dust, dirt, debris, rubbish, and waste materials.

1.19 FINAL DECONTAMINATION

- .1 Perform final decontamination of construction facilities, equipment, and materials which may have come in contact with potentially contaminated materials prior to removal from site.
- .2 Perform decontamination as specified to satisfaction of DCC Representative. DCC Representative will direct Contractor to perform additional decontamination if required.

1.20 REMOVAL AND DISPOSAL

- .1 Remove surplus materials and temporary facilities from site.
- .2 Dispose of non-contaminated waste materials, litter, debris, and rubbish off site.
- .3 Do not burn or bury rubbish and waste materials on site.

- .4 Do not dispose of volatile or hazardous wastes such as mineral spirits, oil, or paint thinner in storm or sanitary drains.
- .5 Do not discharge wastes into streams or waterways.
- .6 Dispose of following materials at appropriate off-site facility identified by Contractor and approved by DCC Representative:
 - .1 Debris including excess construction material.
 - .2 Non-contaminated litter and rubbish.
 - .3 Disposable PPE worn during final cleaning.
 - .4 Wastewater removed from wastewater storage tank.
 - .5 Wastewater generated from final decontamination operations including wastewater storage tank cleaning.
 - .6 Lumber from decontamination pads.
- .7 Dispose of materials as directed by DCC Representative.
- .8 Wastewater sample and analysis: DCC Representative will perform sampling and analysis of stored wastewater for disposal purposes prior to removal from site. Results of analyses will determine appropriate methods of disposal. Upon receipt of analytical results, transfer tank contents without spills or release, as directed by DCC Representative, to liquid waste tankers, disposal area, sanitary sewer, POTW, or off-site disposal facility. Following completion of tank emptying, decontaminate tank interior with steam or high-pressure water wash supplemented by detergent. Dispose of tank decontamination water with tank contents.
- .9 Minimize generation of hazardous waste to maximum extent practicable. Take necessary precautions to avoid mixing clean and contaminated wastes.
- .10 Identify and evaluate recycling and reclamation options as alternatives to land disposal, such as:
 - .1 Hazardous wastes recycled in manner constituting disposal;
 - .2 Hazardous waste burned for energy recovery;
 - .3 Lead-acid battery recycling;
 - .4 Hazardous wastes with economically recoverable precious metals.

1.21 RECORD KEEPING

- .1 Maintain adequate records to support information provided to DCC Representative regarding exception reports, annual reports, and biennial reports.
- .2 Maintain asbestos waste shipment records for minimum of 3 years from date of shipment or longer period required by applicable law or regulation.
- .3 Maintain bills of lading for minimum of 375 days from date of shipment or longer period required by applicable law or regulation.

Part 2 PRODUCTS

2.1 NOT USED

.1 Not Used.

Part 3 EXECUTION

3.1 NOT USED

.1 Not Used.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 **Precedence** - Division 1 sections take precedence over technical specifications in other Divisions of this project manual.

1.2 REFERENCES

- .1 Definitions:
 - .1 Contract Security Program (CSP) - A division of Public Services and Procurement Canada (PSPC), which developed the Contract Security Manual and helps industry to participate in Government of Canada and foreign government contracts. CSP provides security screening services needed for contractors before their employees can work with Protected and Classified information and assets.
 - .2 Company Security Officer (CSO) - The CSO is the organization's official point of contact with the CSP. The CSO is responsible for monitoring the organization's security profile, addressing security issues, and is accountable to the CSP and to the organization's designated Key Senior Official on all industrial security matters.
 - .3 Contractor CSO - The employee of the Contractor's company who is the CSO.
 - .4 Contract Security Manual (CSM) - The CSM is a ready and simple reference which tells Company Security Officers what they must know about Canadian government security standards and procedures and how to ensure that their organization meets these security requirements.
 - .5 Positive Control - Measures which guarantee that persons without appropriate clearance will not be left unattended to access the Department of National Defence/Canadian Armed Forces (DND/CAF) information, assets, resources, or locations.
 - .6 Request for Visit (RFV) - A form to be filled out by an individual who requires access to sensitive DND property, personnel, information, assets and resources because they must be security screened at the appropriate level before commencement of their duties.
 - .7 Restricted - Refers to a situation where authorized persons only, are allowed access to an area or information.
 - .8 Security Implementation Plan - A detailed document which outlines the company's strategy and process to meet contract security requirements.
 - .9 Security Requirements Check List (SRCL) - The SRCL is a Treasury Board Secretariat (TBS) form used to define the security requirements for a contract. The SRCL represents an evaluation of security threats and risks that may arise through the contracting process.
 - .10 Sensitive - Records that are sensitive contain information that can cause different degrees of injury to an individual, a company, or the country if the information were disclosed in an unauthorized manner.
- .2 Reference Sites:
 - .1 Defence Construction Canada (DCC)
 - .1 <https://www.dcc-cdc.gc.ca/industry/security-requirements>
 - .2 PSPC Contract Security Manual
 - .1 <https://www.tpsgc-pwgsc.gc.ca/esc-src/msc-csm/index-eng.html>

1.3 GENERAL

- .1 Security requirements must form part of the contract between DCC and industry when defined by a SRCL.
- .2 These security requirements apply but are not limited to:
 - .1 construction and material objects;
 - .2 contractual arrangements;
 - .3 professional service contracts;
 - .4 facility maintenance contracts; and
 - .5 environmental and UXO contracts.
- .3 A SRCL is a form that is used to define the security requirements associated with each contract. The SRCL ensures that the appropriate security clauses are identified so they may be incorporated into the contract, thereby legally binding the parties to meet the contract's security requirements. **The SRCL must accompany all contract documents including subcontracts that contain security requirements.**
- .4 If multiple levels of screening are required, a Security Classification Guide may have been provided along with the SRCL as a contractual document. This document will provide further information related to security requirements when dealing with multiple levels of clearances within the contract.

1.4 PRIVATE SECTOR ORGANIZATION SCREENING AND CLEARANCES

- .1 Companies who will need access to or who will retain controlled goods, protected or classified property, information, assets or resources must be cleared as follows:
 - .1 Companies must be cleared to safeguard the highest level of information and asset to be retained/accessed, meaning:
 - .1 Designated Organization Screening (DOS) is required for contracts involving access to information at the protected level and/or secure worksites (Reliability status);
 - .2 Facility Security Clearance (FSC) is required for contracts involving access to information at the protected and/or classified levels and/or secure worksites (Secret status);
 - .3 Document Safeguarding Capability (DSC) is required to work on protected and/or classified information at their own worksite; and
 - .4 Companies who will electronically process protected or classified information must have IT media clearance and processing capability commensurate with the security classification level of the information to be processed and must be cleared to the level commensurate with the information or asset to be accessed.

1.5 PERSONNEL SECURITY SCREENING

- .1 Individuals requiring access to information and/or site must have their personnel security screening completed prior to submitting an RFV. As a part of the screening process, it is now a requirement for individuals to undergo a law enforcement inquiry through the RCMP, for electronic finger printing. Please refer to PSPC website for more information.

- .2 Prior to Contract Award, personnel security screenings may not be initiated due to CSP requirements. Therefore, contractors must allow time in their schedules to seek personnel security screenings as required by the contract.
 - .1 Reliability status processing is anticipated to take seven (7) business days per employee after a request has been properly submitted to CSP; and
 - .2 Secret clearance processing is anticipated to take seventy-five (75) business days per employee after a request has been properly submitted to CSP.

1.6 VISIT CLEARANCE REQUESTS (VCR) APPROVAL

- .1 All individuals (including subcontractors) who will have access to sensitive DND or CAF property, personnel, information, assets, and resources, must be security screened at the appropriate level before the commencement of their duties in relation to the contract.
- .2 Access to Operations Zones: security screening is not required for certain personnel if positive control of those individuals is maintained throughout their visit. Positive control measures must be outlined in the Security Implementation Plan. Positive control can be used for the following personnel:
 - .1 Logistics activities – material drop-off, waste removal, snow removal;
 - .2 Transit through an operations zone (no work); and
 - .3 Authorities having jurisdiction.
- .3 The VCR process verifies that those who are permitted access onto DND property have the required clearance level as outlined within the SRCL for the contract.

1.7 POST AWARD PROCESS OVERVIEW

- .1 The Contractor's CSO is provided a blank RFV form by the DCC Representative in order to obtain an approved VCR.
- .2 All employees of the successful bidder who will be accessing restricted sites or sensitive information during the execution of the contract require a VCR. The Contractor's CSO must forward the completed form to the DCC Representative for processing.
 - .1 The CSO of each company completing an RFV form must submit a picklist from the Online Industrial Security Services (OLISS) portal instead of filling in the details of each visitor on the form. Only the employees of the company who require access to the restricted site or sensitive information for that contract shall be listed on the picklist.
 - .2 If the Contractor intends to use Union Hall members, the CSO will request the Union Hall to provide the CSO with a separate picklist for all members to be used on the contract. Only the individuals of the Union Hall who require access to the site for that contract shall be listed on the picklist.
 - .3 The CSO of the company will input "SEE ATTACHED PICKLIST" when completing Particulars of Visitors.
- .3 It is the responsibility of the Prime Contractor to submit and receive an approved SRCL for each subcontract containing security requirements. This responsibility extends to all subcontracts held by subcontractors.
 - .1 Instructions on this process are in the CSM located at <https://www.tpsgc-pwgsc.gc.ca/esc-src/msc-csm/index-eng.html>

- .2 Prior to Contract Award, subcontract SRCL security screenings may not be initiated due to CSP requirements. Therefore, contractors must allow time in their schedules for subcontract SRCL approvals as required by the contract.
 - .1 When a Private Sector Organization Screening (PSOS) is **not** required, contractors shall allow 45 business days (from the date on which a complete and correct subcontract SRCL is received by CSP) for approval of a subcontract SRCL by CSP.
 - .2 When a PSOS **is** required:
 - .1 For sub-contractors to be sponsored to the level of DOS, contractors shall allow for 50 business days (from the date on which a complete and correct PSOS is submitted to CSP) for approval of a subcontract SRCL by CSP; and
 - .2 For sub-contractors to be sponsored to the level of FSC (Secret), contractors shall allow 124 business days (from the date on which a complete and correct PSOS is submitted to CSP) for approval of a subcontract SRCL by CSP.
 - .3 All security related pre-construction activities shall proceed immediately after award.
- .4 For subcontracts, the RFV shall not be submitted until after the subcontract SRCL has been approved and permission to award the contract is granted by CSP.
 - .1 Contractor to allow a minimum of 15 business days for VCR processing.
- .5 Personnel not meeting the required security clearances will not be allowed access to restricted sites or any sensitive information pertaining to the contract, except as permitted in 1.6.2.
- .6 Approved VCRs are valid for the duration of the contract **or** one year less one day, whichever is less. Extension to VCRs will need to be requested as required, again allowing a minimum of 15 business days for processing.

1.8 SUBMITTALS

- .1 Submit to the DCC Representative copies of the following documents, including updates issued:
 - .1 Security Implementation Plan
 - .2 Approved subcontract SRCLs
 - .3 Completed Request for Visit forms for all personnel working under the contract
 - .4 Incident reports within (1) working day
 - .5 Submit other data, information and documentation upon request by the DCC Representative.

1.9 RESPONSIBILITY

- .1 It is the responsibility of the Contractor to have no security breaches while undertaking the work for this contract.

1.10 MEETINGS

- .1 Prior to commencement of work, the Contractor will attend a pre-commencement meeting conducted by the DCC Representative. Ensure, as minimum, attendance by Contractor's site superintendent.

- .1 The DCC Representative will advise of time, date and location of the meeting and will be responsible for recording and distributing the minutes.
- .2 If requested by the DCC Representative, the Contractor's CSO will be required to participate in the pre-commencement meeting.
- .2 Conduct site specific security meetings as required to ensure the management of security is in accordance with the contract.
 - .1 Record and post minutes of all meetings as allowed by the security requirements of the contract.

1.11 SECURITY IMPLEMENTATION PLAN

- .1 Contractors are required to have in place a contract specific Security Implementation Plan that addresses the security requirements outlined in the contract.
- .2 Provide one copy of the Security Implementation Plan to the DCC Representative prior to the commencement of work.
- .3 At a minimum, the plan shall contain details addressing:
 - .1 CSO name and contact information;
 - .2 Schedule for subcontract SRCLs and RFVs;
 - .3 Site Access and Control Monitoring including verification that all people entering secure areas on site have approved VCRs in accordance with contractual security requirements, or any planned positive control measures;
 - .4 Security Education (i.e. Restrictions on photographs); and
 - .5 Security Incident Reporting.
- .4 The DCC Representative will coordinate review of the Security Implementation Plan by the DND Project Security Authority to be completed within 10 business days of receipt following which the DCC Representative shall confirm DND's acceptance or rejection with comments.

1.12 INCIDENT REPORTING

- .1 Investigate and report any security incidents immediately to the DCC Representative.
 - .1 Immediately provide a copy of the incident/investigation reports to the DCC Representative.
 - .2 Refer to Chapter 5 of the CSM <https://www.tpsgc-pwgsc.gc.ca/esc-src/msc-csm/index-eng.html> for more information.
- .2 For the purpose of this contract, immediately notify the DCC Representative of incidents that involve a security breach from the identified clauses on the SRCL or an interruption to adjacent and/or integral infrastructure operations with potential loss implications.
- .3 In the investigation and reporting of incidents, the Contractor is required to respond in a timely fashion (within 5 working days) to correct the action that was deemed to have caused the incident and advise in writing on the action taken to prevent a re-occurrence of the incident.

Part 2 Products

2.1 NOT USED

- .1 Not Used.

Part 3 Execution

3.1 NOT USED

.1 Not Used.

END OF SECTION

Part 1 GENERAL

1.1 SUBMITTALS

- .1 Submit to the DCC Representative copies of the following documents, including updates issued:
 - .1 Site-specific Health and Safety Plan prior to commencement of work on the work site.
 - .2 Reports or directions issued by authorities having jurisdiction, immediately upon issuance from that authority.
 - .3 Accident or Incident Reports, within 24 hrs of occurrence.
- .2 Submit other data, information and documentation upon request by the DCC Representative as stipulated elsewhere in this section.

1.2 COMPLIANCE REQUIREMENTS

- .1 Comply with the latest edition of the Ontario Occupational Health and Safety Act, and the Regulations made pursuant to the Act.
- .2 Observe and enforce construction safety measures required by:
 - .1 National Building Code of Canada (latest edition).
 - .2 Provincial Worker's Compensation Board.
 - .3 Municipal statutes and ordinances.
- .3 Provide and maintain Worker's Compensation Board coverage for all employees for the duration of the contract. Prior to commencement of the work, at the time of Interim Completion and prior to final payment, provide to the DCC Representative a letter of Clearance from the Workers' Compensation Board indicating that the Contractor's account is in good standing.
 - .1 Should the Contractor be a sole proprietor, provide documented proof in a form acceptable to the DCC Representative, of an alternative means of personal coverage that meets or exceeds the requirements set out above for Worker's Compensation Board coverage.

1.3 RESPONSIBILITY

- .1 Carry out work placing emphasis on health and safety of the public, building employees, site personnel and protection of the environment.
- .2 The Contractor is responsible to enforce compliance by its employees and sub-contractors accessing the Work Site with safety requirements of Contract Documents, and all applicable provincial, local statutes, regulations, and ordinances.
- .3 The Contractor is responsible to manage safety of the work site to ensure that any persons, including but not limited to, building employees and the general public circulating adjacent to the work operations are protected against harm due to the extent that they may be affected by conduct of the work.
- .4 The Contractor is responsible to record and post minutes of all site specific occupational health and safety meetings in plain view on the work site. Make copies available to the DCC Representative upon request.
- .5 The Contractor shall designate a Health and Safety Representative if required based on what is perceived to be the number of workers on the site, the size of the project, or any known factor that would cause the need for the designation of a site health and safety representative. If there are no

factors that require the designation of a site health and safety representative, the on-site Superintendent shall be responsible for the required inspections and reporting.

- .6 The Contractor is responsible to designate a competent person or persons to be present on site at all times during the work as the site health and safety representative. The designated person(s) shall be required to conduct regularly scheduled safety inspections of the work site as follows:
 - .1 Informal inspections on a minimum weekly basis noting deficiencies and remedial actions taken in a log book or diary. Make the log book and/or diary available for the DCC Representative's viewing as requested.
 - .2 Formal inspections on a minimum monthly basis, with no less than one (1) inspection for contracts that are less than one (1) month in duration and is to provide a written report to the DCC Representative for each formal inspection, document deficiencies, remedial action needed and assign responsibility for rectification to the appropriate party.
- .7 The Contractor is responsible to ensure Contractor employees and sub-contractors accessing the work site are in possession of and wear appropriate personnel protective equipment (PPE).
- .8 Should an unforeseen or peculiar safety related hazard or condition become evident during performance of work, the Contractor is responsible to immediately take measures to rectify the situation and prevent damage or harm and to advise the DCC Representative verbally and in writing of the hazard or condition.

1.4 SITE CONTROL AND ACCESS

- .1 The Contractor shall be responsible after consultation with the Department of National Defence and the DCC Representative to control all work site access points and work site activities.
- .2 Delineation and isolation of the work site from adjacent and surrounding areas is not possible as the facility must remain fully operational and partially occupied and utilized by the Department of National Defence throughout the duration of the work of this contract.
- .3 The Contractor shall erect visual/physical barriers to define the contractors work space. Coordination for the locations shall be communicated to the DCC Representative.
- .4 Erect signage at access points and at other strategic locations around the work site clearly identifying the work site area(s) as being "off-limits" to non-authorized persons. Signage must be professionally made with well understood graphic symbols and is not to be used as advertising but for the specific use as related to site safety and key contact information.
 - .1 Information to be provided on the signage is as follows:
 - Project Name/Description:
 - Contractor Company Name:
 - Project Superintendent's Name/Phone No.:
 - DCC Point of Contact Name/Phone No.:

1.5 FILING OF NOTICE

- .1 File Notice of Project and any other required Notices with the Provincial/Territorial Authorities prior to commencement of the work. Provide the DCC Representative with a copy of the filed Notice(s) prior to commencement of the work.
 - .1 Where the province/territory does not require any notice to be filed, the DCC site should provide a letter to the provincial/territorial authority advising them of the project.

1.6 PERMITS

- .1 Obtain permits, licenses and compliance certificates at appropriate times and frequencies as required by the authorities having jurisdiction.
- .2 Post all permits, licenses and compliance certificates on work site and provide copies to the DCC Representative.

1.7 PROJECT/SITE CONDITIONS

- .1 The following are the known hazardous substances and/or hazardous conditions at the work site which shall be considered as health or environmental hazards and shall be properly managed should they be encountered as part of the work:
 - .1 Contractors are required to be aware of the known hazardous substances and/or hazardous conditions and are to include in their tender price all work associated in working with, in and around the hazards.
- .2 Obtain from the DCC Representative, a copy of the MSDS data sheets of the existing hazardous materials stored on site or being used by facility personnel in the course of their operations.
- .3 The above lists shall not be construed as being complete and inclusive of all safety and health hazards encountered as a result of Contractor's operations during the course of work. Include above items into the hazard assessment program specified herein.

1.8 MEETINGS

- .1 Prior to commencement of work attend a pre-commencement meeting conducted by the DCC Representative. Ensure at minimum attendance by the Contractor's site superintendent. The DCC Representative will advise of time, date and location of the meeting and will be responsible for recording and distributing the minutes.
- .2 The Contractor is responsible to conduct safety meetings as required by paragraph 1.3 above.

1.9 HEALTH AND SAFETY PROGRAM

- .1 For the purpose of this contract, the Contractor shall perform a hazard assessment of the work site in order to acknowledge, assess and address the hazardous substances and/or hazardous conditions known and identified in paragraph 1.7, and to develop a written site-specific Health and Safety Plan as related to these known hazards. The site-specific Health and Safety Plan shall include provisions for an on-going hazard assessments performed during the progress of work identifying and documenting new or potential health risks and safety hazards not previously known and identified.
- .2 The format of the site-specific Health and Safety Plan shall at a minimum for the purpose of this contract contain the following three (3) parts:
 - .1 Part 1: Detailed description of the project and a list of individual health risks and safety hazards identified by the contractor's detailed site specific hazard assessment(s).
 - .1 List of critical construction activities to be communicated with the DCC Representative which could affect the facility and the occupant operations, or pose a risk to the health and safety of the occupants, Contractor employees and to the general public.
 - .2 Part 2: List of specific measures to control or mitigate each hazard and risk identified in part one of the Plan. Describe the engineering controls, personnel protective equipment, safe work practices and any other applicable means to be implemented and followed when performing work related to each identified hazard or risk. Part 2 of the Plan must also include:

- .1 In the management of safety responsibility, provide the name of the competent employee(s) assigned as site safety representative(s) who is (are) to be present on site at all times during work.
- .2 A written statement, where applicable, that the Contractor has been made aware of known hazards and hazardous substances referred to under paragraph 1.7, and that the Contractor will inform all Contractor employees, sub-contractor employees and any persons affected or potentially affected by the work of this contract of the known hazards.
- .3 A written statement confirming that Contractor employees, sub-contractors and other authorized persons accessing the work site are trained and have been fully instructed in:
 - .1 Safe operation of tools and equipment.
 - .2 Proper wearing and use of personnel protective equipment (PPE) as applicable to the purpose and activities to be conducted on site.
 - .3 Safe work practices and procedures to be followed during the performance of their given work tasks or function on the work site.
 - .4 Work site conditions and minimum site safety rules provided through safety orientation sessions.
- .4 A copy of the Contractor's health and safety policy and disciplinary policy that will be followed to enforce compliance by Contractor employees and sub-contractors with safety requirements of contract documents, applicable regulations and the Contractor's site-specific Health and Safety Plan.
- .3 Part 3: Emergency Measures and Communications Procedures as follows:
 - .1 Emergency Measures: On-site operating procedures, evacuation measures and emergency response to be implemented in the occurrence of an accident or incident. Procedures to be specific and relevant to identified hazards. Measures to complement and be integrated with the Facility Emergency Response Plan(s) in place at site.
 - .2 Confirmation of the location of nearest fire alarm activation box and telephone.
 - .3 A map depicting the location of the nearest emergency medical facility.
 - .4 The location of emergency equipment and supplies including but not limited to first aid kits, emergency eye wash stations, spill kits/equipment and fire extinguishers. Including confirmation that equipment and supplies have been verified/certified for use.
 - .5 The names of all persons assigned responsibility by the Contractor as a first aid attendant at the project.
 - .6 An inventory listing the common name of all controlled products (WHMIS Products) that the Contractor knows or intends to bring to the project site. List to be updated as necessary as project proceeds.
 - .7 A copy of the Contractor's accident/incident investigation policy and incident and accident report form(s) to be used by the Contractor to document any incident or accident that might occur during the course of project work
 - .8 Communication procedures:
 - .1 List of names and telephone numbers of designated official(s), to be contacted should an incident or emergency situation occur, including the following:
 - .1 Contractor and all sub-contractors.

- .2 Federal and Provincial departments and local emergency resources organizations, as applicable to the hazards identified and type of accident or incident which might occur, in accordance with applicable laws and regulations.
- .2 Procedures implemented at site to communicate and share information between Contractor employees, sub-contractors, and the Contractor on work site activities and in particular those which might endanger employees and facility occupants.
- .3 The procedure to be followed by contract personnel to initiate emergency response by fire, police and medical personnel.
- .4 Post a copy, including all updates, of the Health and Safety Plan in a common visible location at work site.
- .3 Provide one copy of the site-specific Health and Safety Plan to the DCC Representative prior to commencement of work on the work site.
- .4 Provide and maintain one copy of the site-specific Health and Safety Plan at the work site, in a location that is easily accessible by all Contractor employees, sub-contractor employees and any persons affected or potentially affected by the work of this contract.

1.10 MINIMUM SITE SAFETY RULES

- .1 Notwithstanding the requirement to abide by provincial health and safety regulations, the following safety rules shall be considered minimum requirements at the work site and obeyed by all persons accessing the work site:
 - .1 Wear PPE appropriate to the function and task while on the work site.
 - .2 Immediately report unsafe activities, conditions, near miss accidents, injuries and damages.
 - .3 Maintain the work site in a tidy condition.
 - .4 Obey warning signs and safety tags.

1.11 ACCIDENT REPORTING

- .1 Investigate and report incidents and accidents as required by the Ontario Occupational Safety and Health Act, and the Regulations made pursuant to the Act.
- .2 For the purpose of this contract immediately investigate and provide a report to the DCC Representative on incidents and accidents that involve:
 - .1 A resulting injury that may or may not require medical aid but involves lost time at work by the injured person(s).
 - .2 Exposure to toxic chemicals or substances.
 - .3 Property damage.
 - .4 Interruption to adjacent and/or integral infrastructure operations with potential loss implications.

1.12 RECORDS ON SITE

- .1 Maintain on site a copy of the safety documentation as specified in this section and any other safety related reports and documents issued to or received from the authorities having jurisdiction.
- .2 Upon request, make copies available to the DCC Representative.

Part 2 Products

2.1 NOT USED

.1 Not used.

Part 3 Execution

3.1 NOT USED

.1 Not used.

END OF SECTION

Part 1 General

1.1 CONSTRUCTION FIRE SAFETY

- .1 The Contractor shall provide construction fire safety in accordance with the National Fire Code of Canada.

1.2 FIRE DEPARTMENT BRIEFING

- .1 DCC Representative will co-ordinate arrangements for Pre Commencement Meeting following contract award. Contractors will be briefed on Fire Safety by the Fire Chief or his designated representative before work starts.

1.3 REPORTING FIRES

- .1 The Contractor shall inform the DCC representative and Fire Chief of all fire incidents at the construction site, regardless of size.
- .2 Know location of nearest fire alarm pull station and telephone, including emergency phone number.
- .3 Report immediately fire incidents to Fire Department as follows:
 - .1 Activate nearest fire alarm pull station.
 - .2 Telephone.
- .4 Person activating fire alarm pull station will remain at the front entrance to direct Fire Department to scene of fire.
- .5 When reporting fire by telephone, give location of fire, name or number of building and be prepared to verify location.

1.4 FIRE SAFETY PLAN

- .1 Submit a fire safety plan for the construction site prior to commencement of construction work. The fire safety plan shall conform to the National Fire Code of Canada.
- .2 The fire safety plan shall be submitted to the DCC representative for review by local fire department. Any comments by local fire department shall be implemented by the Contractor.
- .3 The fire safety plan shall be limited to the area of construction only. Contractor is not responsible for amending fire safety plans in existing buildings.
- .4 Post the fire safety plan at the entrance to the construction site or near the construction site's health and safety board.
- .5 The fire safety plan shall conform to the National Fire Code of Canada, and shall contain, at minimum:
 - .1 Emergency procedures to be used in case of fire, including
 - .1 Sounding the fire alarm;

- .2 Notifying the fire department;
- .3 Instructing occupants on procedures to be followed when the fire alarm sounds;
- .4 Evacuating occupants, including special provisions for persons requiring assistance; and
- .5 Confining, controlling and extinguishing fires.
- .2 The appointment and organization of designated supervisory staff to carry out fire safety duties.
- .3 The training of supervisory staff and other occupants in their responsibilities for fire safety.
- .4 Documents including diagrams, showing the type, location and operation of building fire emergency systems.
- .5 The holding of fire drills (where applicable).
- .6 The control of fire hazards in the building.
- .7 The inspection and maintenance of building facilities provided for the safety of occupants.

1.5 FIRE WARNING SYSTEM

- .1 Provide a fire warning system for entire construction site, capable of notifying construction personnel of a fire emergency in construction area.
- .2 Provide system with sufficient coverage so that alarms are capable of being heard throughout building and anywhere on site.

1.6 FIRE PROTECTION SYSTEM IMPAIRMENT

- .1 Maintain existing systems in an operational state at all times during construction.
- .2 Use of fire hydrants, standpipes or hose systems for purposes other than fire fighting unless authorized by Senior Fire Fighter, is prohibited.
- .3 Existing fire protection and alarm systems will not be obstructed, shut off, disabled or left inactive at end of each working day or shift without written authorization from Senior Fire Fighter.
- .4 Submit written notification to DCC Representative and Senior Fire Fighter 48 hours in advance of planned interruption of services. Submit written notification for operation including shutting down active fire protection system, including water supply, fire suppression, fire detection and life safety systems.
- .5 Where a fire protection system that provides fire alarm monitoring is impaired in an existing building, provide a fire watch as directed by Senior Fire Fighter.
- .6 Conduct work on fire protection system where systems are affected or impaired in accordance with National Fire Code of Canada conforming to Base Fire Orders.

1.7 FIRE EXTINGUISHERS

- .1 Supply fire extinguishers, as scaled by Senior Fire Fighter, necessary to protect work in progress and contractor's physical plant on site.
- .2 Provide supplemental fire extinguishers to these areas and otherwise as directed by Senior Fire Fighter:
 - .1 Adjacent to hot works.
 - .2 Areas where combustibles materials are stored.
 - .3 Adjacent to areas where flammable liquids or gases are stored or handled.
 - .4 Near or on internal combustion engines.
 - .5 Adjacent to temporary oil fired or gas fired equipment.
 - .6 Adjacent to bitumen heating equipment.
- .3 Provide extinguishers rated as follows: 4A:40BC. Minimum 20 pounds unless otherwise directed by Senior Fire Fighter.
- .4 Provide dry chemical type extinguishers unless otherwise required by hazard being protected.
- .5 Provide sufficient numbers of extinguishers based on a maximum travel distance between extinguishers of 23.0 meters (75 feet).

1.8 ACCESS FOR FIRE FIGHTING

- .1 Provide and maintain access for firefighting in accordance with National Fire Code of Canada.
- .2 Provide written notification to Senior Fire Fighter a minimum of 5 working days in advance of operation that would impede fire apparatus response including:
 - .1 Violation of minimum horizontal and overhead clearances.
 - .2 Other operations as directed by Senior Fire Fighter.
 - .3 Erecting of barricades and digging of trenches.
- .3 Maintain a minimum clear horizontal width on access routes of 5.0 meters or otherwise as defined by Senior Fire Fighter.
- .4 Maintain a minimum vertical clearance of 6.0 meters or otherwise as defined by Senior Fire Fighter.

1.9 SMOKING PRECAUTIONS

- .1 Smoking is prohibited in buildings including buildings under construction.
- .2 Obey posted signs and confine smoking only to designated smoking areas. Observe posted smoking restrictions near existing buildings.

1.10 RUBBISH AND WASTE MATERIALS

- .1 Keep rubbish and waste materials at minimum quantities.
- .2 Burning of rubbish is prohibited.

- .3 Remove rubbish from work site at end of work day or shift or more frequently as directed by Senior Fire Fighter.
- .4 Storage:
 - .1 Store oily waste in approved receptacles to ensure maximum cleanliness and safety.
 - .2 Deposit greasy or oily rags and materials subject to spontaneous combustion in approved receptacles and remove specified.

1.11 FLAMMABLE AND COMBUSTIBLE LIQUIDS

- .1 Handling, storage and use of flammable and combustible liquids governed by current National Fire Code of Canada.
- .2 Keep flammable and combustible liquids such as gasoline, kerosene and naphtha for ready use in quantities not exceeding 45 litres provided they are stored in approved safety cans bearing Underwriters' Laboratory of Canada or Factory Mutual seal of approval. Storage of quantities of flammable and combustible liquids exceeding 45 litres for work purposes requires permission of Fire Chief.
- .3 Transfer of flammable and combustible liquids is prohibited within buildings or jetties.
- .4 Transfer of flammable and combustible liquids will not be carried out in vicinity of open flames or any type of heat producing devices.
- .5 Use of flammable liquids having flash point below 38 degrees C such as naphtha or gasoline as solvents or cleaning agents is prohibited.
- .6 Storing flammable and combustible waste liquids on site is prohibited. Remove daily or more frequently as directed by Senior Fire Fighter.

1.12 HOT WORK

- .1 Implement a hot works program in accordance with National Fire Code of Canada and NFPA 51B Standard for Fire Prevention. Apply hot works program to processes involving welding, cutting, roofing and other hot works as defined by Senior Fire Fighter.
- .2 Obtain a "Hot Works" permit from Senior Fire Fighter for hot works in construction area. Frequency of renewal for hot works permits is at discretion of the Senior Fire Fighter.
- .3 When work is carried out in dangerous or hazardous areas involving use of heat, provide fire watchers equipped with sufficient fire extinguishers. Determination of dangerous or hazardous areas along with level of protection necessary for Fire Watch is at discretion of the Senior Fire Fighter.
- .4 Provide fire watch service for work as directed by Senior Fire Fighter and as defined in Fire Department Briefing. Provide fire watchers trained in use of fire extinguishing equipment.
- .5 Carry out hot works processes in areas free of combustible and flammable content.
- .6 Where hot works must be carried out in areas where combustibles are present:

- .1 Protect flammable and combustible materials within 15.0 meters of hot works in accordance with National Fire Code of Canada.
- .2 Provide a fire watch during hot work and for a minimum of 60 minutes after work is complete unless otherwise directed by Senior Fire Fighter.
- .3 Conduct a final inspection of area not less than 4 hours after completion of hot works unless otherwise directed by Senior Fire Fighter.
- .7 Where there is a possibility of sparks leaking onto combustible materials in areas adjacent to areas where the hot work is carried out:
 - .1 Cover or close openings in walls, floors or ceilings to prevent passage of sparks to such adjacent areas.
 - .2 Provide a fire watch during hot works and for a minimum of 60 minutes after work is complete.
 - .3 Conduct a final inspection not less than 4 hours after completion of hot works unless otherwise directed by Senior Fire Fighter.
- .8 Protection of flammable or combustible materials:
 - .1 Remove flammable and combustible materials including combustible or flammable dust or residue from area where hot works is carried out.
 - .2 When removal is not possible, protect materials with a non combustible covering.
- .9 Provide a fire extinguisher within 3.0 meters of hot works. Provide a minimum size of 20 lbs Type ABC extinguisher unless otherwise directed by Senior Fire Fighter.

1.13 HAZARDOUS SUBSTANCES

- .1 Perform work involving the use of toxic or hazardous materials, chemicals or explosives, or otherwise creating hazard to life, safety or health, in accordance National Fire Code of Canada (NFC).
- .2 Provide ventilation where flammable liquids, such as lacquers or urethanes are used. Eliminate sources of ignition. Provide written notification to the Senior Fire Fighter a minimum of 5 days prior to starting work and immediately at completion of work.

1.14 PARTIAL OCCUPANCY

- .1 Implement partial occupancy procedures as defined in General Conditions of the Contract. Partial occupancy is defined as when construction occurs adjacent to work areas occupied by Departmental or Canadian Forces personnel. This includes:
 - .1 Phased new construction.
 - .2 Early or partial occupancy of new construction.
 - .3 New construction being added onto an existing building.
 - .4 Renovation or recapitalization of an existing building.
 - .5 Phased renovation or recapitalization of an existing building.
- .2 Where partial occupancy occurs, implement requirements as indicated in drawings and specifications. This may include construction of a rated fire separation between occupied and construction areas as required by National Fire Code.

- .3 If work is carried out in an occupied building, provide regular inspections every hour, throughout entire period of demolition.
- .4 If work is carried out in an occupied building and where building does not have a Fire Alarm system or similar automatic monitoring or protection equipment, provide regular inspections every hour for entire period of construction.

1.15 QUESTIONS AND/OR CLARIFICATION

- .1 Direct questions or clarification on Fire Safety to DCC Representative.
- .2 DCC Representative will obtain clarifications from Senior Fire Fighter. Do not contact directly with Senior Fire Fighter for notification, authorization or any requests unless situation constitutes an immediate emergency.

1.16 FIRE INSPECTION

- .1 Co-ordinate site inspections by Senior Fire Fighter through DCC Representative.
- .2 Allow Senior Fire Fighter unrestricted access to work site.
- .3 Co-operate with Senior Fire Fighter during routine fire safety inspection of work site.
- .4 Immediately remedy unsafe fire situations observed by Senior Fire Fighter.

Part 2 Products

2.1 NOT USED

- .1 Not Used.

Part 3 Products

3.1 NOT USED

- .1 Not Used.

END OF SECTION

1 References

FEDERAL

- .1 Applicable Base/Wing Environmental Administrative Instructions (AI) or Wing Standing Orders (WSOs) are available, as required, to the Contractor after award.
 - .1 Directorate Contaminated Sites (DCS) Contaminated Sites Instruction (CSI.004.001) - Soil Management. V. 4.3, 22 October 2025.
 - .2 Directorate Architecture and Engineering Services (DAES) Standard on the Management of Asbestos Containing Material (ACM) in DND Immovables. 01 October 2024.
 - .3 Wing Standing Order (WSO) 15.01 *Environmental Protection*. January 2026.
 - .4 WSO 15.04 *Emergency Response to Hazardous Material Spills*. January 2026.
 - .5 WSO 15.08 Halocarbon Management. January 2026.
 - .6 WSO 15.10 *Storage Tank Systems*. January 2026.
 - .7 WSO 15.12 *Excess and Imported Soil Management*. January 2026.
- .2 Canadian Council of Ministers of the Environment (CCME). *Canadian Environmental Quality Guidelines, Canadian Water Quality Guidelines for the Protection of Aquatic Life, Total Particulate Matter*, 2002.
- .3 Canadian Council of Ministers of the Environment. (CCME). *Environmental Code of Practice for Aboveground and Underground Storage Tank Systems Containing Petroleum and Allied Petroleum Products*. PN 1326. 2003.
- .4 *Canadian Environmental Protection Act 1999*. Statutes of Canada 1999 Chapter 33.
 - .1 Federal Halocarbon Regulations, 2022. SOR/2022-110.
 - .2 PCB Regulations. SOR/2008-273.
 - .3 Storage Tank Systems for Petroleum Products and Allied Petroleum Products Regulations. SOR/2008-197.

- .5 *Canada Labour Code- Canadian Occupational Health and Safety Regulations* (SOR/86-304). 2019.
- .6 *Environmental Code of Practice for Elimination of Fluorocarbon Emissions from Refrigeration and Air Conditioning Systems* (the Environment and Climate Change Canada “Refrigeration Code of Practice”). April 2015, Errata 2021.
- .7 *Code of Practice for the Environmental Sound Management of End-of-Life Lamps Containing Mercury*. Environment and Climate Change Canada. 2017.
- .8 *Fisheries Act*. Revised Statutes of Canada 1985, Chapter F-14.
- .9 *Migratory Birds Convention Act, 1994*.
- .10 *Species at Risk Act*, 2003. Chapter 25-29, no.3.
- .11 *Transportation of Dangerous Goods Act* and pursuant regulations.

PROVINCIAL

- .12 *Ontario Water Resources Act*. Revised Statutes of Ontario 1990, Chapter O.40.
- .13 *Technical Standards and Safety Act, 2000* and pursuant regulations, codes, and standards. Statutes of Ontario 2000, Chapter 16.
- .14 *Environmental Protection Act*. Revised Statutes of Ontario 1990, Chapter E.19.
- .1 Ontario Regulation 103/94. *Industrial, Commercial, and Institutional Source Separation Programs*.
- .2 Ontario Regulation 153/04. *Records of Site Condition*. Part XV.1 of the Act.
- .3 Ontario Regulation 347. *General—Waste Management*. Revised Regulations of Ontario 1990.
- .4 Ontario Regulation 362. *Waste Management – PCB’s*.
- .5 Ontario Regulation 406/19. *On-site and Excess Soils*.
- .6 Ontario Regulation 903. *Wells*.

- .15 *Occupational Health and Safety Act*. Revised Statutes of Ontario 1990, Chapter O.1.
 - .1 Ontario Regulation 490/09. *Designated Substances*.
 - .2 Ontario Regulation 278/05. *Designated Substance – Asbestos on Construction Projects and in Buildings and Repair Operations*.
- .16 Ontario Ministry of Labour. 2011. *Lead on Construction Projects*.
- .17 Ontario Ministry of Labour. 2011. *Silica on Construction Projects*.
- .18 Ontario Provincial Standard Specifications. Ontario Ministry of Transportation.
 - .1 OPSS 182. General Specification for Environmental Protection for Construction in Waterbodies and on Waterbody Banks.
 - .2 OPSS 518. Construction Specification for Control of Water from Dewatering Operations.
 - .3 OPSS 801. Construction Specification for the Protection of Trees.
 - .4 OPSS 805. Construction Specification for Temporary Erosion and Sediment Control Measures.

MUNICIPAL

- .19 Corporation of the City of Quinte West Noise By-law (08-127)

2 Related Sections

- .1 01 35 43.01 Soil Management

3 Submittals

- .1 Submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Prior to commencing construction activities submit an Environmental Protection Plan (EPP). The EPP must meet the intent of the contract and must be acknowledged as reviewed by the DCC Representative prior to work commencement.
- .3 The Environmental Protection Plan to include the following sub-Plans:
 - .1 Spill Prevention Response Plan (SPRP).

- .2 Erosion and Sediment Control Plan (ESCP).
- .3 Water Diversion and Dewatering Plan (WDDP).
- .4 Soil Management Plan (SMP).
- .5 Waste Management and Disposal Plan (WMDP).
- .4 Submit other data, information and documentation upon request by the DCC Representative and as stipulated elsewhere in this section.

4 Designated Substances

- .1 In accordance with Section 30 of Ontario's *Occupational Health and Safety Act*, following is a list of designated substances present at the project site:
 - .1 Asbestos-containing materials (ACM) is potentially present in the exterior cladding, the insulation behind the exterior cladding, and the interior walls panels of Building B052 (Hangar 10).
 - .1 The Contractor will test surfaces containing potential ACM prior to the disturbance of the material.
 - .2 Disturbance to asbestos-containing materials shall be conducted in accordance with Ontario Regulation 278/05 and Canada Labour Code – Canada Occupational Health and Safety Regulations SOR/86-304 (COHSR).
 - .2 Lead based paint is present in Hangar 10.
 - .1 Disturbances to lead painted surfaces shall be conducted in accordance with the Ministry of Labour Guideline "*Lead on Construction Projects*" (2011).
 - .2 Contractor is required to have painted surfaces sampled and analyzed for toxicity characteristic leaching procedure (TCLP) metals analysis in accordance with O. Reg. 347 to define the appropriate waste classification.
 - .1 For bidding purposes, lead-containing wastes are to be assumed to be non-leachate toxic, non-hazardous waste and will be transported and disposed of as regular waste.
 - .3 Silica is present in all concrete materials throughout the project site.

- .1 Disturbance of materials containing silica shall be conducted in accordance with the Ministry of Labour Guidelines “*Silica on Construction Projects*” (2011).
- .4 Inform all workers and sub trades of the presence of designated substances and hazardous materials identified in the contract documents.
- .5 Immediately notify the DCC Representative of potential asbestos containing material (ACM) discovered during the work and not apparent from the drawings, specifications, or reports pertaining to the Work. Do not disturb such material.
- .6 For additional reference information concerning designated substances at Hangar 10, refer to report titled *Designated Substances and Hazardous Materials Survey, DCC Project No. HQ1562DC, 52 North Star Drive, CFB Trenton, ON, Building 52 - Hangar 10* prepared by Golder Associates Limited, dated August 2021.

5 General

- .1 Comply with all federal, provincial, and municipal regulatory requirements and guidelines for environmental protection and natural resource conservation, including in section 1.0 References, noted above.
- .2 The Work site is subject to inspection by the Base Environment Officer, or designate, as well as, the DCC Representative, without prior notice.
- .3 Failure to comply with environmental requirements may result in a stop work order or assessment of damages commensurate with repair of damage.
- .4 All references to payment referred to in OPSS references are to be disregarded and do not apply to this contract.
- .5 The Contractor will be unable to request extra funding to meet environmental requirements that are within the contract.
- .6 It is the Contractor’s responsibility to be aware of environmental requirements and the best management practices and pollution control measures necessary to meet them.
- .7 The Project Site will be kept tidy and organized. Debris will be removed on a daily basis.
- .8 Blasting is not permitted on DND property.
- .9 Fires and burning of rubbish are not permitted on DND property.

- .10 Location for excavated material, staging areas, and fueling areas will be established at least 31 metres away from the high water mark of water bodies.
- .11 Excavated material will be tested prior to removal from DND property or removal to a location within DND property..

6 Spill Prevention and Response Plan

- .1 A spill or release is an accidental discharge of a pollutant (solid, liquid or gas) into the environment. After a spill or release, always ensure human health and safety is protected above all else.
- .2 Submit to the DCC Representative a project-specific Spill Prevention and Response Plan (SPRP) prior to work on-site.
 - .1 The SPRP shall include environmental response measures necessary to prevent and to mitigate a pollutant release on National Defence property.
 - .2 The SPRP is to include:
 - .1 Contact information for the designated qualified individual to be the Environmental Protection Coordinator (EPC).
 - .2 Roles and responsibilities including names of those responsible for managing the SPRP.
 - .3 List of all subcontractors including contact information to support the SPRP.
 - .4 Notification to the DCC Representative for any spill.
 - .5 Emergency spill response measures, see **6.6** below.
 - .6 Project and site-specific clean up measures for spills,
 - .7 Waste disposal, including disposal procedures for materials used to contain the spill and storage location for these materials.
 - .8 Procedure to escalate for spills beyond Contractor's ability to manage the spill.

- .9 Refueling operations shall be conducted within a secondary containment area, on an impermeable surface and on hard-stand surface. Refuel equipment no closer than 31 metres from the ordinary high water mark of water bodies. SPRP shall identify equipment fueling location, the machinery to be refueled, location of transfer area, methodology and control measures during refueling.
- .3 Identify high-risk locations where spills are probable and maintain spill kits, capable of handling the largest potential spill through the duration of the project, at these locations. The Contractor will locate PPE at the top of the spill kit to ensure easy access for the spill responder. The spill kits will be kept closed with a safety seal affixed to indicate if the kit has been used or tampered with.
- .3 The SPRP is to be modified and updated as necessary. On-going assessments shall be performed during the progress of work identifying and documenting new or potential spill hazards and measures not previously known and identified.
- .4 Prior to starting work, provide to the DCC Representative an inventory of hazardous material to be brought to the site, including volume or mass, and Safety Data Sheets (SDS).
- .5 An Environmental Incident Report / 8 Wing CFB Trenton Hazardous Materials Spill Response and Reporting form shall be completed by the Contractor for any spill or release incidents, regardless of the quantity spilled. The form is included in this Section.
- .6 Emergency Response:
 - .1 With respect to liquid spills, contractor shall have on-site equipment to control a liquid spill of 110% of any material brought on to—or handled at—the site for one (1) hour.
 - .2 The on-site spill control kit required to include absorbent pads, absorbent granular, nitrile gloves, garbage bags and/or pails with lids, and shovels, and applicable to the chemical used.
 - .1 A spill control kit shall be located wherever quantities of materials or wastes that may require emergency spill response are used or stored.
 - .3 In the event of a spill, invoke Contractor's SPRP Plan and make immediate notifications to the DCC Representative.

- .4 In the event of a spill into the natural environment, do everything practicable to prevent, eliminate, and ameliorate adverse effects, and to restore the natural environment.
- .5 Emergency response planning is to include measures to escalate the response in the event of an emergency that exceeds on-site equipment capabilities.
- .7 Display an information placard on all such material and equipment containing liquid products that will be located overnight or longer on DND property.
 - .1 Information placards to include: Contractor's name and address, contact person, emergency telephone numbers, and liquid contents.
 - .2 Post the information placard either on the exterior of the container, or on the dashboard of the vehicle, where applicable.
- .8 All petroleum, oil and lubricant (POL) products used in association with the project shall be transported, stored, handled and disposed of in accordance with the Transportation of Dangerous Goods Act.
- .9 Contaminated sediments and/or water are not permitted to flow into waterbodies. These effluents will require collection and special disposal.
- .10 Where possible, biodegradable hydraulic fluids will be used in equipment.
- .11 Vehicles and equipment will be inspected for leaks. Drip pans will be used if required.
- .12 Equipment and vehicle staging areas, material storage, and waste storage will be designated in the laydown area prior to work commencing with setbacks greater than 31 m from the ordinary high water mark of surface water or drainage features.
- .13 When possible, a mobile fuel truck will be used for all refuelling of equipment and machinery within the refuelling area.
- .14 Measures to protect existing groundwater monitoring wells present within work areas will be included in the SPRP.

7 Erosion and Sediment Control Plan

- .1 Establish and submit to the DCC Representative an Erosion and Sediment Control Plan (ESCP) prior to start of work on-site. The ESCP must be updated, modified and resubmitted at the direction of the DCC Representative as necessary if existing sediment and erosion control measures are proving inadequate.
- .2 Ensure the ESCP plan addresses unforeseen storm events with associated potential overland erosion from rainfall impact and storm water run-off. The Contractor will consult, at a minimum, the following documents to ensure the plan avoids causing death of fish (Section 34.4(1)), or harmful alteration, disruption or destruction of fish habitat (Section 35(1)) under the Fisheries Act and fulfill provincial regulations for protection of water quality and aquatic ecosystem.
 - .1 ESCP to include the following information:
 - .1 Name and contact information for designated qualified individual to be the Environmental Protection Coordinator.
 - .2 Any subcontractors and contact information to support the ESCP.
 - .3 A drawing showing location of site work that requires erosion and sediment controls and type to be installed. Include location of stockpiles, laydown areas for machinery/materials and dewatering locations.
 - .4 A schedule of work for installation, monitoring, and removal.
 - .5 Sample checklist and details of how and when inspections will be performed to ensure control measures follow the contract documents.
 - .6 All erosion and sediment control measures must ensure that sediment-laden water is not discharged from the site. This shall include but is not limited to sediment and erosion control measures indicated on the contract drawings.
 - .7 A list of municipal, provincial and federal permits and/or notifications the Contractor must obtain (as per the contract documents) to complete the work.
 - .8 Emergency procedures in the event of a failed Erosion and Sediment Control measure.

- .2 Contractor to submit, to the DCC Representative, and maintain a record showing date of construction, repairs or alternations (initialization and completion) and removal of each erosion and sediment control measure.
 - .1 Digital photographs of all ESC measures at time of construction, at time of any major repair or alternation and just prior to removal.
 - .2 Checklists of all ESC measures in place at that time, recording date, time and persons inspecting ESC measures. Required repairs to be indicated on the record for each ESC measure.
 - .3 Ensure control measures are in compliance with ESCP and Federal, Provincial and Municipal laws and regulations.
- .3 Dewatering systems must be capable of controlling ingress of water during work, as well as prevent surface runoff into excavation.
- .3 Prevent the release of water containing suspended materials into any waterways, storm drains, sanitary sewers, or drainage systems. Control disposal and/or runoff of water containing suspended materials or other harmful substances in accordance with regulatory requirements.
- .4 Berm barriers are not permitted.
- .5 Store any stockpiles of soil or fill material at least thirty-one (31) metres from the ordinary high water mark of water bodies and protect them with either a heavy duty or light duty sediment barrier.
- .6 Where required, the Contractor will place stockpiled soil on an impermeable surface and will cover the stockpile with an impermeable, properly secured tarp. Water contained in the stockpiled soil must be properly contained and managed to prevent runoff of sediment to surface water bodies.
- .7 Have additional sediment control materials readily available in case they are needed promptly for erosion and sediment control.
- .8 Maintain sediment controls in good condition until terrestrial vegetation has re-established or area stabilized.
- .9 Remove captured sediment before dismantling sediment barriers.
- .10 Erosion and sediment control measures will be implemented prior to the land disturbance in areas where there is potential surface run-off to sensitive receptor such as drainage ditches, catch-basins, or water features.

- .11 Work will be scheduled to avoid wet, windy and rainy periods that may increase erosion and sedimentation where possible.
- .12 Minimize the area of soil exposed at any one time by: phasing construction activities; retaining vegetation as much as possible; and, once construction works are completed, stabilizing any exposed soils as soon as possible using temporary measures such as mulch, erosion sediment control blankets, hydro-seeding, and/or plastic sheeting or replanting exposed soils with an approved seed mix or long-term vegetation.
- .13 Inspect the control measures regularly during the course of construction and make all necessary repairs if any damage occurs. If the sediment and erosion control measures are not functioning properly, no further work shall occur until the sediment and/or erosion problem is addressed.

8 Water Diversion and Dewatering Plan

- .1 Provide a Water Diversion and Dewatering Plan (WDDP) outlining the measures to be taken in the event that water is encountered in the excavation.
- .2 As per the 2025 Soil and Groundwater Characterization Report by Gemtec, laboratory analysis of groundwater samples collected from groundwater monitoring wells within the footprint of new pumphouse, fire water supply line and water main line - BH24-01, BH24-02 and BH24-04 - indicated concentrations of selenium and chloride in BH24-04 (MW24-04) exceeding the CCME guidelines protective of aquatic life in freshwater over long term exposures and below the MECP Table 3 SCS. The report will be provided after award of contract.
- .3 WDDP to include the following:
 - .1 Name and contact information of the qualified person designated to prepare and supervise the WDDP.
 - .2 Names and contact details for all sub-contractors to support the WDDP.
 - .3 The method to provide a temporary holding area or tank(s) to maintain water on site with pumping as necessary to keep excavations and the construction site free of water. Include details on:

- .1 How captured water is to be filtered or settled out prior to discharge back to the site in a manner to allow infiltration to the subsurface soils without overland runoff containing sediments to storm sewers.
- .2 Pump sizes and specifications.
- .3 Filtering material to be used to trap and contain suspended sediment.
- .4 Drawings to show collection areas or tanks, location of pumps/hoses and filter areas, and outfalls and discharge areas the Contractor is responsible for managing as per the contract.
- .5 The sampling procedure of water or effluent at the discharge location and how it will comply with contract documents and legislative requirements. Sampling procedure to include:
 - .1 Number of samples to be taken and frequency of sampling.
 - .2 The laboratory to be used for sampling and the parameters to be sampled for (e.g. TSS, turbidity etc.).
 - .3 Method of communication for results to DCC Representative.
- .6 Contingency procedures (including equipment to be used) in the case of a breach of water diversion and/or release of sediment to a waterbody or storm sewer.
- .7 Procedure for notifying the DCC representative of the containment, transport and disposal of contaminated water or sediments.
- .8 Name, contact information, location and copy of licence of receiver facility to accept the waste. Include disposal method for filtering materials (e.g. sediment bags, filter cloths, geofabrics etc.)
- .9 Procedures for water diversion and/or dewatering measures removal that ensures no surge of water and minimizes erosion or sediment release.
- .10 Restoration procedure after removal of water diversion and/or dewatering measures.
- .11 Details on permits or approvals required.

- .4 The WDDP will be submitted to the DCC Representative prior to any work on-site and must be acknowledged as reviewed by DND prior to work commencement.
- .5 Site isolation measures are to be implemented for containing suspended sediments.
- .6 Site isolation measures will be implemented to minimize water flowing onto the site and into excavation areas.
- .7 Pumps shall be on site to dewater the work site as necessary. Pumps shall be sized by the Contractor.
- .8 When all work within a construction area is complete the area shall be restored to avoid a surge of water and minimize erosion.
- .9 If any contaminated groundwater is discovered or suspected during the work (e.g. sheen on water surface, hydrocarbon odour), stop work in the immediate area and immediately contact the DCC Representative.
- .10 Water (from precipitation and groundwater infiltration) will not be pumped/discharged offsite until sampling and analysis have confirmed that the water meets discharge criteria as approved by DND or designated DCC Representative.
- .11 Water discharge to the aquatic environment must meet the CCME Water Quality Guidelines for the Protection of Aquatic Life.
- .12 Employ flocculation tanks, settling basins or other treatment facilities to ensure water meets the discharge criteria applicable to the point of discharge.
- .13 Water containing deleterious substances is not allowed to be pumped into surface water features, storm sewer or drainage systems.

9 Waste Management and Disposal Plan

- .1 Submit a Waste Management and Disposal Plan (WMDP) to the DCC Representative before construction work begins at the site. The WMDP is to comply with legislation, best practices, and with the requirements of the specifications.
- .2 The WMDP is to encompass:
 - .1 Regular waste,

- .2 Construction waste,
- .3 Hazardous materials used in the course of the work, and
- .4 Hazardous materials and designated substance waste.
- .5 The WMPD shall include items below in addition to 10.3 through 10.10
 - .1 Name and contact information for the designated qualified individual to be the Environmental Protection Coordinator (EPC)
 - .2 A list of all contractors and Receiver Facilities for all waste types.
 - .1 Waste carriers' business name, address, telephone, email address, and MECP Certificate(s) of Approval listing the hazardous materials approved for transportation.
 - .3 The anticipated waste shipment frequency for all waste.
 - .4 Detailed procedures to be used to manage all waste products stored on site (petroleum, oil, lubricants and other hazardous waste to be detailed specifically). Include types of containers, labeling and segregation)
 - .5 A description of the types of waste materials and expected quantities for storage, transport and disposal. For leachate toxic waste include detailed compliance with O.Reg 347 and Transportation of Dangerous Goods Act (TDGA).
 - .1 Include procedure for notifying DCC Representative of the transport of hazardous materials and/or designated substances (including asbestos) offsite.
 - .6 Procedures for storing and release of hazardous materials to be removed from site including manifest procedures.
 - .7 Procedures that detail requirements for the below Special Substances that detail what is contained in the specification.
 - .1 Mechanical Flushing Liquids to Sanitary Sewers including lab analysis report, notifications and contacts.
 - .2 Smoke detectors

.3 Polychlorinated Biphenyls (PCBs)

.3 Waste Handling:

- .1 Ensure that staff are properly trained and equipped, in accordance with regulatory requirements.
- .2 Minimize handling and exposure to hazardous materials. Use control measures such as PPE and best practice procedures to address potential risks.
- .3 All waste products will be placed in suitable containers and labeled clearly.
 - .1 Waste products are to be segregated by commodity and placed in separate containers based on class.
 - .2 Similar waste products are not to be mixed together without prior approval from the DCC Representative.

.4 Storage:

- .1 Identify location(s) on site where wastes and hazardous materials wastes will be stored.
- .2 Store all petroleum, oil, lubricants, and other hazardous materials within secondary containment, or in an appropriate metal clad storage building with containment.
- .3 Store incompatible materials separated to prevent reaction.
- .4 Access to hazardous waste storage areas must be controlled through appropriate physical barriers and limited to authorized personnel.
- .5 Site is to be kept neat and orderly at all times.

.5 Transportation:

- .1 Transportation of hazardous material must be in accordance with the *Transportation of Dangerous Goods Act*, by a licensed hauler, and in approved containers.

.2 Hazardous Materials Waste shall **not** be released from a work site to a carrier that is not registered as a carrier for the specific Hazardous Materials Waste, nor shall it be released for delivery to a consignee that is not registered as a receiver for the specific Hazardous Materials Waste.

.1 Leachate toxic materials must be manifested for removal.

.6 Disposal:

.1 Identify the proposed waste receiver facilities and the anticipated waste shipment frequency for all wastes.

.2 Contractor is required to have painted waste sampled and analyzed for toxicity characteristic leaching procedure (TCLP) metals analysis in accordance with O. Reg. 347.

.1 Sample(s) are to be taken by a Qualified Person (QP) (as defined in O. Reg. 153).

.2 Results are to be provided to DCC Representative for review prior to disposal off-site.

.3 Disposal of leachate toxic lead-based paint as hazardous materials must comply with legislation on transport and disposal.

.1 Record the weight of abated paint sent for disposal.

.4 Dispose of all materials that are removed as asbestos-containing materials as asbestos waste.

.7 Transport and Disposal of Hazardous Waste and Designated Substances:

.1 Provide DCC Representative written notification of intent to transport of hazardous materials or designated substances off site, including but not limited to hazardous and liquid industrial waste (i.e. oils, solvents, waste fuels, used spill clean-up materials) or designated substance waste (i.e. asbestos, leachate toxic lead paint, mercury vapour in fluorescent light tubes).

.2 For shipments that require a waste generator number pursuant to O. Reg. 347, the Base waste generator number is required prior to removal offsite and will be provided by the DCC Representative.

.3 Submit the following to the DCC Representative for review 5 days prior to transport:

- .1 Description and approximate quantity of waste material to be sent for disposal, including substrate if applicable.
- .2 Contractor proposed date and time for hazardous waste material shipment.
- .3 Correspondence from the approved hazardous waste receiver, indicating agreement and intent to accept the specified hazardous materials waste on specified date.
- .4 Coordinate with the DCC Representative so that the Base Hazardous Materials Officer or designate is present at the time of shipment to review, sign and document hazardous waste transport from the Base.
- .5 Submit the following to the DCC Representative for review within 48 hours following transport from the Base:
 - .1 Landfill weigh scale receipt/ticket for the disposal of waste.
- .8 Disposal of Mechanical Flushing Liquids:
 - .1 Mechanical flushing liquids and mechanical liquids include any mechanical systems (piping, units, etc.) such as HVAC, glycol and includes residual liquid in current systems, cleaning with chemical inhibitors or cleaners, and flushing of new piping.
 - .2 Mechanical flushing liquids are to be assumed for bidding purposes to be hazardous waste and shall be transported and disposed of at a licensed facility in accordance with O. Reg. 347, and as described in this specification for Shipment and Disposal of Hazardous Waste and Designated Substances.
 - .3 In the event the contractor wants to discharge to a sanitary sewer the contractor must undertake the following items:
 - .1 Provide DCC Representative written notification of intent to discharge mechanical flushing liquids to sanitary sewer.
 - .2 Mechanical flushing liquids and mechanical liquids that are not authorized to be discharged to sanitary sewer shall be transported and disposed of at a licensed facility in accordance with O. Reg. 347, and as described in this specification for Shipment and Disposal of Hazardous Waste and Designated Substances.

- .9 Do not bury rubbish or waste materials on DND Property.
- .10 Do not dispose of waste into any waterways, storm or sanitary sewers, drainage system, or onto land.
- .11 Divert unused asphalt material from landfill to be reused offsite or recycled.
- .12 All solid and liquid hazardous waste material generated by work are to be taken off Base and disposed of in a lawful manner and at appropriately accredited facilities.
- .13 All expenses incurred for the handling, storage, analysis, transport and disposal/recycling of all wastes will be incurred by the Contractor.

10 Site Clearing and Plant Protection

- .1 Protect trees and plants on site and adjacent properties as indicated.
- .2 Do not use tree protection areas for storage, stockpiling or any other purpose. Do not dump or flush any contaminants in areas of tree feeder roots.
- .3 Obtain DCC Representative's approval where it is necessary to encroach onto protected area, prior to proceeding.
- .4 Do not attach rigging cables to trees.
- .5 Restrict construction activities to the project footprint in order to prevent damage to vegetation outside the work areas.
- .6 To limit compaction, off-road activities will be limited to routes authorized by DND/DCC that avoid effects to species at risk and minimize effects to vegetation. Restrict the storage of machinery and equipment to pre-disturbed areas (e.g. parking lots, roads) whenever possible. Where possible, limit off-road operation of equipment, machinery and vehicles when ground is dry.
- .7 Restore all disturbed areas. In areas where sod is not required, vegetate disturbed areas with native seed mix approved by DCC/DND to prevent the establishment of invasive species. Restore disturbed areas to function as they did in their pre-disturbance condition. The seeded areas will be covered with mulch to prevent erosion and to help seeds germinate.
- .8 Ensure machinery and materials arrive on site in a clean condition and are maintained free of invasive species and noxious weeds.

- .9 Schedule site restoration activities as soon as work is completed to prevent erosion.
- .10 If there is insufficient time remaining in the growing season for the seeds to germinate, the Contractor will stabilize the site (e.g., cover exposed areas with erosion control blankets to keep the soil in place and prevent erosion) and implement site restoration activities as soon as the growing season permits.
- .11 Maintain effective sediment and erosion control measures until re-vegetation of disturbed areas is achieved.
- .12 Work is to be staged in currently developed areas. Vehicles and other equipment are to stay on already developed roadways.
- .13 Do not use pesticides/herbicides during re-seeding or sodding.
- .14 Remove vegetation using mechanical or hand clearing method. They will not use biocides.

11 Wildlife Protection

- .1 Nesting structures for birds are to remain intact without harm to the nest.
 - .1 If these features are encountered the Contractor is to stop work and notify the DCC Representative immediately for direction on how to proceed;
 - .2 Depending on the nest and bird species, setbacks for disturbance zones maybe defined.
 - .3 It is prohibited to damage, destroy, or remove a nest of a migratory bird that is occupied by a bird or its egg, without a permit or an authorization.
- .2 The Contractor will comply with the *Migratory Birds Convention Act*, 1994.
- .3 Prior to work commencing, conduct ground surveys to ensure that wildlife are not nesting/denning on or immediately adjacent to the project site.
 - .1 Where found, immediately notify the DCC Representative;
 - .2 Maintain a minimum setback distance of 3 m from wildlife burrows/dens and maintain markers indicating wildlife burrows/dens.

- .4 The Contractor will stop work if wildlife enters the Site. Work will not commence until wildlife have vacated the vicinity of the Work Area. Wildlife will be allowed to exit the site on their own, via safe routes. Onsite personnel are prohibited from capturing, handling or harassing wildlife. In the event that wildlife in the Work Area appear to be injured, abandoned, or in distress, onsite personnel will immediately notify the DND through the DCC Representative.
- .5 The Contractor will report all wildlife encounters and sightings to DCC Representative.
- .6 If a wildlife den is observed during construction, the Contractor shall cease work in the immediate area of the den and contact the DCC Representative.
- .7 The Contractor will cover excavations left open overnight if possible. Place one end of a plank into larger excavations to provide an escape ramp, and check all excavations for wildlife before refilling.
- .8 The Contractor will limit potential sources of shelter by covering or containing piles of soil, fill, brush, rocks and other loose materials, capping ends of pipes; and ensuring that trailers, bins, boxes, and vacant buildings are secured at the end of each workday.
- .9 The Contractor will ensure all potential sources of water are minimized by limiting standing pools of water within the Work Areas. Fence off or barricade temporary storm water ponds and other water bodies and/or sumps within the Work Areas.
- .10 The Contractor will ensure no pesticides are used in areas that will be identified as habitats during the predisturbance wildlife surveys.
- .11 Ensure all food wastes are secured in wildlife-proof containers and are removed promptly from the Site (particularly in warm weather).
- .12 Ensure on-site containers are enclosed to limit contact with rain and runoff and prevent light materials from blowing out. Ensure on-site containers are not easily accessible by wildlife (e.g., gulls, fox, racoons).

12 Soil Management

- .1 Refer to section 01 35 43.01 Soil Management.

13 Unanticipated Soil Contamination

- .1 Refer to General Condition GC 4.4

- .2 Should unanticipated soil contamination be discovered:
 - .1 Stop work and assess the situation for safety.
 - .2 If situation does not appear to be safe, evacuate workers from area.
 - .3 If safe to do so, take immediate steps to control any spread of contamination, in accordance with Contractor's spill response plan.
 - .4 Immediately contact the DCC Representative for direction on how to proceed.

14 Pollution Prevention - Water

- .1 Protection of Storm Drains:
 - .1 Protect storm drains within work site and within roadway that borders work site (which may be outside of work site) against entry by sediment, debris, oil, or chemicals prior to any work on-site and maintain until completion of work.
 - .2 Discharge of sediment-laden water to storm sewer is not permitted.
 - .3 Catch basins and catch basin manholes within work site and within roadway that borders work site (which may be outside of work site) to have a double layer of geotextile placed under lids to prevent sedimentation of storm sewer system. The geotextile shall be maintained until the completion of work.
 - .4 Ditch inlets to be protected by flow check dam immediately upstream of ditch inlet until all areas draining into the ditch inlet have been permanently stabilized.
- .2 Protection of Drinking Water:
 - .1 In the event of a water main break, leak or disruption, Contractor is to stop work and notify the DCC Representative immediately.
 - .2 Water mains are to be disinfected with a 12% solution of sodium hypochlorite specific for drinking water supplies.
 - .3 Coordinate with DCC Representative to have the Department of National Defence's water authority; Water, Fuel and Environment (WFE) witness the connection, disinfection and flushing procedures as well as collect residual chlorine and bacteria samples.

- .4 Repeat disinfection procedure of water main as required in order to achieve acceptable test results.
- .3 Protection of Groundwater Monitoring Wells:
 - .1 Groundwater monitoring wells present within excavation limits will be decommissioned in accordance with Ontario Regulation 903 prior to excavation activities.
 - .2 The Contractor is responsible to repair any damage to existing monitoring wells. Work to be completed in compliance with Ontario Regulation 903.
 - .3 The DCC Representative will, upon request, show the Contractor the location of all known monitoring wells.
- .4 Protection of Waterbodies:
 - .1 Do not operate construction equipment in waterways.
 - .2 Do not use waterway beds for borrow material.
 - .3 Do not dump excavated fill, waste material or debris in waterways.
 - .4 Chlorinated drinking water is considered a deleterious substance by Environment and Climate Change Canada (ECCC).
 - .5 Contractor is to ensure that hydrant discharge does not enter or is likely to enter fish habitat by direct or indirect discharge with measurable levels of free reactive chlorine (CCME).
 - .6 Discharging to land is permitted subject to the use of matting to prevent loss of soil or vegetation ensuring that items above are complied with.
 - .7 Comply with requirements of OPSS 182 "General Specification for Environmental Protection for Construction in Waterbodies and on Waterbody Banks". A written strategy is required by paragraph 182.04 to be submitted to the DCC Representative before commencing work on site. Disregard references to OPSF 182-1.

15 Pollution Prevention - Land

- .1 Take all measures necessary to prevent dust and mud tracking on adjacent roads and streets.

- .1 Use mechanical sweepers as often as necessary to keep adjacent roads and streets clean of dust and mud that is deposited from this project.
- .2 Spray water to minimize the release of dust from paved areas or exposed soils. During wetting or misting, avoid the creation of excess water, which would require drainage control.
 - .1 Chemical dust suppressants to be used only as approved by the DCC Representative.
- .3 Maintain temporary erosion and pollution control features installed under this Contract, and those in place pre-dating the Contract.
- .4 If materials are to be transported between sites, prevent any loss of material during transit.
- .5 Remove excess soil from equipment, machinery and vehicles.
- .6 Cover or wet down dry materials or rubbish to prevent blowing dust and debris.
 - .1 Cover or otherwise contain loose materials that have potential to release airborne particulates during their transport, installation or removal.
 - .2 Cover stockpiled materials.
 - .3 Stabilize soil and other material storage piles against wind erosion.
 - .4 Minimize vehicle traffic on exposed soils and stabilize high traffic areas with clean gravel surface layer or other suitable cover material.
 - .5 Avoid excavation, or other construction activity with potential to release airborne particulates, during windy and prolonged dry periods.
 - .6 Restore disturbed areas as soon as possible to minimize the duration of soil exposure.
 - .7 Lawn care pesticides are prohibited.
 - .8 Secure covers on waste bins and dumpsters at the end of each working day so as to prevent unauthorized use.
 - .9 Secure covers on waste bins and dumpsters so as to shed rain.

- .10 Cover dust-producing materials with 6 millimetre polyethylene sheeting (at a minimum).
- .11 Sweep haul roads and construction site daily.
- .12 Employ proper truck loadings.
- .13 Enforce speed control on site.

16 Pollution Prevention - Air

- .1 Prevent material/dust from sandblasting, saw-cutting, and other operations from affecting air quality beyond application area, by providing temporary enclosures.
- .2 Ensure vehicles, heavy equipment and machinery are in good operating condition and equipped with emission controls including muffler/exhaust system baffles and engine covers per regulatory requirements.
- .3 Comply with operating specifications for heavy equipment and machinery.
- .4 Minimize the operation and idling of vehicles and avoid operating and idling vehicles and gas-powered equipment during smog advisories.
- .5 Control emissions from equipment and plant to conform with federal, provincial, and municipal requirements.
- .6 Reduce emissions as per Environment Canada's *Best Practices for the Reduction in Air Emissions from Construction and Demolition Activities*, 2005.
- .7 Isolate building air intakes and openings (windows, doors, entrances, etc.) to ensure that no emissions are entrained to buildings.
- .8 When possible, use compression ignition engines that meet the Tier 4 emission standards during all phases of the project.
- .9 Consider prevailing weather conditions and weather forecast (i.e., gusting winds, wind direction, heavy rainfall, snowfall, etc.) prior to the commencement of activities.
- .10 Workers will wear appropriate PPE to manage dust (minimum – disposable face masks for particulate matter smaller than $<10\ \mu\text{m}$ (PM 10)) when dust is generated

.11 Products and Materials:

- .1 Use products and materials that are as free as possible of noxious or toxic volatile emissions or emissions of irritating or toxic particles, so that the interior air of the completed building is as pollution-free as possible. For example, products emitting benzene, mercury, lead, or other known toxic compounds are not acceptable.
- .2 Where odourless products are not available, choose products where possible so that odours are minimized. Set ventilation levels during the construction period sufficiently high to encourage the off-gassing of materials to their minimum levels prior to occupancy of the building, where possible.
- .3 Choose products for installation within the air-handling and distribution systems to minimize the introduction of pollutants into the fresh air supply to the building.
- .4 Remove oily rags and other combustible debris from Site daily. Take every precaution necessary to prevent spontaneous combustion.

17 Storage Tank System - Installations

- .1 Installation of storage tanks are to comply with the *Storage Tank Systems for Petroleum Products and Allied Petroleum Products Regulations* as well as the Environmental Code of Practice for Aboveground and Underground Storage Tank Systems Containing Petroleum and Allied Petroleum Products under the *Canadian Environmental Protection Act*.
 - .1 Documentation is to be provided confirming that the system was installed by a person approved to do so in the province of Ontario.
 - .2 All components of the system must bear certification marks indicating that they conform to the standards set out in the Storage Tank Regulations bearing a certification mark conforming with either CAN/ULC, EI (formerly API), or CSA-B837.
 - .3 Notify the DCC Representative of the Storage Tank System installations. All storage tanks installed on DND/CAF facilities shall have the registration forms submitted to the DCC Representative for DND registration.
- .1 All petroleum product and allied petroleum product storage tanks shall be installed by a person approved to do so in the province of Ontario.

- .1 Provide certificates to the DCC Representative before commencing installation work.
- .2 The contractor will install the tank in accordance with “*Storage Tank Systems for Petroleum Products and Allied Petroleum Products Regulations SOR/2008-197*”. The Contractor will provide as-built drawings bearing the stamp of a professional engineer in accordance with *SOR/2008-197*. The drawings will include:
 - .1 the outline of all tanks;
 - .2 the centreline of all piping;
 - .3 the centreline of all underground electrical power and monitor sensor conduits;
 - .4 the building foundation outlines;
 - .5 the property lines; and
 - .6 the secondary containment system
- .3 The Contractor will fill out the “DND DAES Storage Tank System Registration Form” which will be provided to them by the DCC Representative.
- .4 Storage Tanks owned and used by the Contractor must be registered with ECCC and registration number clearly visible at the point of fill of the storage tank, unless the storage tank is designed to transport fuel and possesses a Transport Canada certification number (DOT/UN/CGSB).
- .5 Notify the DCC Representative of storage tanks installed in open areas where floor drains, conduits, and other floor penetrations are found.
- .6 Contractors that bring their own storage tanks on to a Base/Wing must provide to the DCC Representative proof of registration with ECCC and the registration number clearly visible at the point of fill on the storage tank.

18 Archaeology

- .1 Artifacts can include broken housewares, garbage, bits of uniforms, ships or boats, timber, ammunition, building materials, building foundations, cut stone, stone drains, animal bones, human bones, coins or tokens, ash pits, fire pits, encampments, Aboriginal materials, pottery, etc.
- .2 During excavations, watch for the following: patterns; off-colour soils (either light or dark); any sorts of the artifacts noted above.

- .3 Upon discovery of artifacts, stop work in that area and notify the DCC Representative.
- .4 If required, DND will retain an archaeologist licensed in Ontario to monitor all excavation work or disturbance of the existing ground.
 - .1 Coordinate through the DCC Representative for monitoring of excavations by the archaeologist.
 - .2 A minimum 48 hours notice is required for any excavation in which archaeological monitoring has been stipulated.

19 Unanticipated Unexploded Ordnances (UXO)

- .1 Should unanticipated UXO be discovered:
 - .1 Stop work and assess the situation for safety. Do not touch or remove UXO.
- .2 If situation does not appear to be safe, evacuate workers from area.
- .3 If safe to do so, take immediate steps to section off the area of the UXO with barriers to access.
- .4 Immediately contact the DCC Representative who will notify Base authorities.

20 Halocarbon Management

- .1 Halocarbons are ozone-depleting substances that are used as refrigerants, solvents and for fire suppression.
- .2 Comply with the:
 - .1 Federal Halocarbon Regulations (FHR), 2022. SOR/2022-110.
 - .2 *Environmental Code of Practice for Elimination of Fluorocarbon Emissions from Refrigeration and Air Conditioning Systems* (the Environment and Climate Change Canada “Refrigeration Code of Practice”). April 2015.
- .3 Installation, servicing, operation must be completed by a certified person as defined in the FHR 2022.

- .1 Provide copies of all technicians' certificates to the DCC Representative.
- .4 The following are the only halocarbons that are acceptable as refrigerants (non-halocarbon refrigerants are also acceptable):
 - .1 HFC 410A;
 - .2 HFC 134A;
 - .3 HFC 404A.
- .5 Document **all** work—installation, maintenance, decommissioning, leak testing on refrigeration and air conditioning systems using the 8 Wing Trenton Refrigeration and Air Conditioning Service Log, and adhere to the FHR 2022 and DND requirements. Obtain forms from DCC Representative. Mount forms upon equipment.
- .6 Affix bar code tags to the equipment, as provided by the DCC Representative.
- .7 Immediately report all releases of halocarbons to the DCC Representative.
 - .1 Complete the 8 Wing Halocarbon Report / Spill Release Incident Form and provide to 8 Wing Environment through DCC Representative within 12 hours.
- .8 Leak-test all halocarbon-containing equipment within 24 hours of arrival at the Base, in accordance with the FHR 2022 and the *Refrigeration Code of Practice*.
- .9 Leak-test all nitrogen-charged or “empty” equipment within 24 hours of arrival at the Base, in accordance with the FHR 2022 and the *Refrigeration Code of Practice*.
- .10 Leak-test halocarbon-containing equipment during Commissioning in accordance with the FHR 2022 and the *Refrigeration Code of Practice*.
 - .1 Complete Base activity log forms.
- .11 After installation, leak-test factory-charged halocarbon-containing equipment in accordance with the FHR 2022 and the *Refrigeration Code of Practice*.
 - .1 Complete Base activity log forms.

- .12 Comply with the following timelines for service activity log completions,
- .1 Factory charged units containing more than 10 kg of halocarbon shall be leak tested within 2 (two) working days of delivery to site.
 - .2 Commissioning of units requires forms to be submitted to DCC Representative within 48 hours of service;
 - .3 Leak Test with “no leaks”, submit forms to DCC Representative within 48 hours of service;
 - .4 Leak Test with “leak detected”, submit forms to DCC Representative within 12 hours of service;
 - .5 Leak repaired and isolation or emptying of system, submit forms to DCC Representative within 5 days of service;
 - .6 Release of halocarbons >10 kg and <100 kg, submit forms to DCC Representative within 12 hours of service;
 - .7 Release or potential release of halocarbons > 100 kg, submit forms to DCC Representative immediately;
 - .8 Decommissioning of units requires forms to be submitted to DCC Representative within 48 hours of service.

.13 8 Wing Trenton Refrigeration and Air Conditioning Service Log Form

For this type of work...	...complete these items in these Sections			
	A	B	C	D
Commissioning	All	All	1.0, 1.1, 1.2, 3.0	1 through 6, 13
Leak Test	All	All	All	1, 2, 3, 5, 6, 7, 13
Servicing of Sealed Systems Only (Refrigerant Circuit)	All	All	All	1 through 9, 13
De-Commissioning	All	All	Not applicable	1, 2, 5 through 13

SECTION A. ☐ Commissioning ☐ Leak Test ☐ Servicing
 ☐ Decommissioning

Building No. _____ Operator _____

Room No. _____ Owner _____

Owner Address _____

Equipment Description _____

SECTION B.

Work Order No. _____ Service Date _____

Model Number _____ Serial Number _____

Contracting Company/Technician Employer _____

Technician/Contractor Name (print) _____

Technician's Trade Certificate No. _____ Expiry Date _____

SECTION C.

ACTIVITY	YES	NO	COMMENTS
1.0 Leak Test Performed			Date of Last Leak Test: _____
1.1 Leak(s) Detected			
1.2 Leak(s) Repaired			
2.1 Halocarbon Recovered From System			
2.2 Halocarbon Isolated in System			
3.0 System Charged With Halocarbon			FACTORY ☐ FIELD ☐

SECTION D.

1. Technician's ODS Awareness Card No. _____ Expiry Date _____

2. Type of Halocarbon _____

3. Halocarbon Charge Capacity _____ (kg) (lb) (oz). Amount of Halocarbon Charged (kg) (lb) (oz)

4. Charged by: ☐ Contractor ☐ Factory ☐ DND (give DND cylinder No. _____)

5. Cooling Capacity of System _____ (tonnes) (BTU) (kW)

National Defence
8 Wing Trenton
Project No: 500006750

Environmental Protection

Section 01 35 43
Page 31 of 33
2026-02-02

6. Halocarbon charged per circuit (1)_____ (2)_____ (3)_____ (4)_____ (5)
(kg) (lb) (oz)
7. Type of Halocarbon Recovered _____
8. Amount of Halocarbon Recovered _____ (kg) (lb) (oz)
9. Recovered into cylinder owned by: ☐ Contractor _____ ☐
DND (give DND cylinder No) _____)
10. Final Destination of Equipment _____
11. Final Destination of Halocarbon _____
12. Final Destination of Refrigerant Oil _____
13. Technician Signature _____

Submit form to RM Supervisor, 39 Alert Blvd. Fax (613) 965-7590. Questions to 392-2811 extension 2377

Submit form to DCC Representative

**.14 8 Wing Halocarbon Report – Notification Type: HH
Spill Release Incident HX33 Release/Discharge**

GENERAL SPILL / RELEASE REPORT INFORMATION

Malfunction Discovered / Occurrence:	Date:	Time:
Malfunction Stopped / Cleaned:	Date:	Time:
Spill Reporting Date:	Date:	Time:

DESCRIPTION - LOCATION OF SPILL / RELEASE & EQUIPMENT

Unit / Section Name	
Building Civic Address	
DND Building & Room Number	
Type of System / Equipment	
Equipment / System Number / ID	#
DND DRMIS FLOC #0437-XXXX-XXXX	#
Equipment / System Make & Model	
Equipment / System Serial Number	

INFORMATION – HALOCARBON SPILL / RELEASE / LEAK DETAILS

Type of Halocarbon / Refrigerant					
Total Charging Capacity			lbs	x 0.4536	Kg
Quantity Released / Discharged			lbs	x 0.4536	Kg
Quantity Recovered			lbs	x 0.4536	Kg
Subj Coding HH - Leak Location Found					
Leak Detection Method Used					
Cause of Spill Release / Discharge			Describe:		
Leak Tested	YES	NO			

CORRECTIVE ACTIONS TAKEN / RECOMMENDED PREVENTATIVE MEASURES

Describe:

TECHNICIAN'S INFORMATION - REPORTED BY:

Technician's Name		Phone	
Technician's ODP/ODS	#	Expiry	
Supervisor / Resp. Person's Name			
Company's Name	DND RP Ops or Company's Name:		

ADDITIONAL COMMENTS - If any outside agencies involved, provide contact info & details:



REPORTING INSTRUCTIONS: Within 12 hours of occurrence or discovery, submit this completed Report by:



1. Sending an e-Copy to DND 8 Wing Environment by email, DWAN: +8 Wing Environment@CFB Trenton@Trenton
Direct email addresses: Andrew.Tam OR Alan.Brown @forces.gc.ca or via FAX: 613-965-3368.



2. Hand delivering this Original Copy to DND RP Ops Det Trenton RM Shop Main Office: B164 South, 39 Alert Blvd.
Refs: *Canadian Environmental Protection Act (1999) – Federal Halocarbon Regulations (SOR 2022-110)*; 8 Wing Standing Orders 15.04
(8 WEnv), 23.06 (RP Ops Det Trenton RM Shop) – 8 Wing Halocarbon Report, Version 3.0 (06/2025)

.15 8 Wing/CFB Trenton Hazardous Material Spill Response and Reporting

1. Spill reported by:	Name & Initials:	Phone #:	Unit:
2. Spill Occurrence - Date:		Spill Start Time:	Spill Stop Time:
3. Source of Spill:		Location of spill: (reference to a geographical location) GPS (Deg°, min', sec") Lat/Long:	
4. a. Hazardous Material Spilled:		b. Quantity Spilled (Litres/Kg): Quantity Recovered:	
c. Weather conditions (snow -rain – dry)		d. Spill clean up completion time: Spill cleaned up by:	
5. Cause of Spill (be brief):			
6. Effect(s) of Spill (be brief):			
7. Distance (in meters) from point of release to nearest:			
a. Water Well:		c. Catch Basin or Drain:	
b. Property Boundary:		d. Surface water course (i.e. creek, bay, etc):	
8. Details of action, taken or proposed, to mitigate effects of spill:			
9. Internal/External agencies notified.			
10. Off -Base agencies that responded to spill:			
11. Aircraft Fuel Jettisons			
a. Tail # and Call Sign:			
b. Type of fuel		c. Quantity jettisoned (lbs):	
d. Altitude of jettisoning (m):		e. Ground temperature during jettisoning (°C):	
f. Duration of fuel jettison (min):		g. Aircraft velocity during jettisoning (Kt/hr):	
h. average wind speed between ground level and jettisoning altitude (kt/hr):		i. Wind orientation (relative to aircraft) during jettisoning (parallel/not parallel):	
NOTE: Forward this report to 8 Wing Environment Officer (WEnvO Andrew.Tam@forces.gc.ca) and 8 Wing HazMat Officer (WHazMatO Alan.Brown@forces.gc.ca) within 12 hours of incident; or fax 613-965-3368			

END OF SECTION

1 References

FEDERAL

- .1 Applicable Base/Wing Environmental Administrative Instructions (AI) or Wing Standing Orders (WSOs) will be provided to the Contractor after award.
 - .1 DCS CSI (CSI.004.001) - Soil Management. V. 4.3, 22 October 2025.
 - .2 Wing Standing Order (WSO) 15.12 Excess and Imported Soil Management, January 2026.
- .2 Canadian Council of Ministers of the Environment (CCME). *Canadian Environmental Quality Guidelines (CEQGs)*.
- .3 *Canadian Environmental Protection Act 1999*. Statutes of Canada 1999 Chapter 33.
- .4 Health Canada's drinking water guidelines and screening values. April 2019.
- .5 *Transportation of Dangerous Goods Act* (S.C. 1992, c. 34) and pursuant regulations.

PROVINCIAL

- .6 *Aggregate Resources Act*, R.S.O. 1990, c. A.8.
- .7 *Environmental Protection Act*. Revised Statutes of Ontario 1990, Chapter E.19.
 - .1 Ontario Regulation 153/04. *Records of Site Condition*. Part XV.1 of the Act. Amended to Ontario Regulation 407/19. *Records of Site Condition*. Part XV.1 of the Act.
 - .2 Ontario Regulation 347. *General—Waste Management*. Revised Regulations of Ontario 1990.
 - .3 Ontario Regulation 406/19. *On-site and Excess Soil Management*.
- .8 Ontario Landscape Horticultural Association. 2004. *Ontario Landscape Standard Chapter 5 Topsoil Standard*.

- .9 Ontario Ministry of Transportation. *Ontario Provincial Standard Specifications (OPSS)*. Technical Publications.
- .10 *Ontario Water Resources Act*. Revised Statutes of Ontario 1990, Chapter O.40.
- .11 *Technical Standards and Safety Act, 2000* and pursuant regulations, codes, and standards. Statutes of Ontario 2000, Chapter 16.
- .12 MECP Rules for Soil Management and Excess Soil Quality Standards s.3 pg.23 Soil Characterization Report.
- .13 MECP Rules for Soil Management and Excess Soil Quality Standards s.2 pg 18-19 In Situ / Stockpile Sampling

2 Related Sections

- .1 01 35 43 Environment Protection

3 Submittals

- .1 Submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Prior to commencing any construction activities, the following submittals are to be submitted and confirmed by the DCC Representative:
 - .1 Soil Management Plan (SMP). See Section 5 for minimum mandatory contents of the SMP.
 - .1 As part of the SMP, the Contractor is required to submit a Soil Sampling Plan.
- .3 Approval of the SMP from the DND Representative is required prior to work commencing on site.
- .4 The Contractor will allow up to 5 business days for review of the SMP by DCC and DND Representatives.
- .5 Submit other data, information, and documentation upon request by the DCC Representative and as stipulated elsewhere in this section.
- .6 All soil movement on DND Property must be tracked. Submit at contract close out a Summary Soil Management Tracking Report to include soil volumes transported and disposed, Source and Receiver Site location and soil movement dates.

4 General Soil Management

- .1 Comply with all federal, provincial, and municipal regulatory requirements and guidelines for environmental protection and natural resource conservation, as noted in Section 1 References.
 - .1 All references to payment referred to in OPSS references are to be disregarded and do not apply to this contract.
- .2 The Work Site is subject to inspection by the Base/Wing Environment Officer, or representative, as well as the DCC Representative, without notice.
- .3 Failure to comply with environmental requirements may result in a stop work order or assessment of damages commensurate with repair of damage.
- .4 The Contractor will be unable to request extra funding to meet environmental requirements that are within the contract.
- .5 It is the Contractor's responsibility to be aware of environmental requirements and the best management practices and pollution control measures necessary to meet them.
- .6 Soil and groundwater quality is known for areas within the footprint of the new pumphouse, fire water supply line, and water main line. Laboratory analysis of soil samples indicated exceedance of boron and molybdenum in one or more soil samples when compared against the CCME Agriculture criteria, and below the CCME Residential/Industrial criteria and MECP Table 3.1 ICC Excess Soil Quality Standards. Detected concentrations of PFAS were below the 2025 Health Canada PFAS Soil Screening Values for federal contaminated sites in Agricultural/Residential/Parkland land use setting. Laboratory analysis of groundwater samples indicated exceedance of selenium and chloride in one location when compared against the CCME guidelines protective of aquatic life in freshwater over long term exposures, and below the MECP Table 3 Site Condition Standards. The 2025 Soil and Groundwater Characterization Report prepared by Gemtec can be provided to the Contractor after award of contract.
- .7 Blasting is not permitted on DND property.
- .8 Fires and burning of rubbish are not permitted on DND property.

5 Minimum Soil Management Plan (SMP) Requirements

- .1 The SMP will include soil characterization, soil quantities, considerations for water table excavations, disposal options for excess soil, stockpile locations and management plan, decontamination procedures and soil re-use plan.

.2 Contact Information and Responsibilities

- .1 Provide contact information the Qualified Person (QP) as per O. Reg. 153/04 and O. Reg. 406/19 who will sample and characterize any excess soil or fill material to be removed or imported from the Work Site.
- .2 Provide sub-contractor/consultant contact information to support the SMP.
- .3 SMP to be signed by the Qualified person.

.3 Imported Soil/Fill to the Work Site

- .1 Documentation on imported fill will be reviewed by the DCC Representative and DND Environment Officer representative prior to bringing to site.
- .2 Provide a description of the type of imported material (Granular A, stone dust, crusher run, etc.).
 - .1 Include sieve analysis showing less than 20% fines (if requesting exemption from testing) and proposed estimated quantity for each type of material.
- .3 In cases where fill material is not exempt, provide a letter report from the Source Site (prepared and signed by a QP) meeting CCME criteria as per the contract, for imported fill material.
 - .1 Letter to include:
 - .1 Name, address and Ontario license number of source quarry/pit.
 - .2 Land Use Classification of imported fill destination.
 - .3 Confirmation that the material is from a virgin source and not recycled.
 - .4 Confirm that the number of samples meets O. Reg. 153/04.
 - .5 Certificates of Analysis from laboratory.
 - .6 Sampling methodology and QA/QC adhered to.

.7 Summary table of analytical results, highlighting any exceedances to the applied Land Use Classification (CCME CEQG) for parameters outlined in the contract.

.8 Any sampling plan changes and results of sampling.

.4 Excess Soil/Fill Disposal Off the Work Site

.1 For excess soil transport and disposal, including contaminated soil, provide:

.1 The Receiver facility contact information (name, address, email, phone number).

.2 Environmental Compliance Approval (ECA).

.3 Provide a letter of acceptance from the Receiving Site based on analytical results.

.4 Include submittals of manifest copies and weigh bills.

.2 Detail sampling requirements as per O.Reg 153/04 and O. Reg 406/19 for excess soils to be disposed of from the Site. Include:

.1 The number of samples as per O.Reg 153/04.

.2 Contaminant parameters to be sampled as per the contract.

.3 Confirmation of the use of laboratories accredited to the International Standard ISO/IEC 17025 by the Standards Council of Canada (SCC) or the Canadian Association for Laboratory Accreditation (CALA).

.5 Soil Reuse at the Work Site or Disposal on DND Property

.1 Explain procedures for managing soils to be reused at the Work Site which includes stockpiles and handling of soil.

.1 Details to include covering stockpiles to prevent water intrusion, mixing avoidance, deposit location of stockpiles, separation of topsoil from vegetation and from other soils (e.g. imported, excess, contaminated).

.6 Soil Sampling Plan to include:

.1 The name of the licensed/permitted Source Site and Receiver Site from which the material will be provided.

.2 The number of samples required to meet to CCME guidelines.

.3 A description of the type imported material (aggregate, fill) and proposed quantity.

- .4 All samples shall be submitted to an SCC or CALA) accredited laboratory for analysis.

6 Management of Reuse and Excess Soil

- .1 For bidding purposes assume existing soil quality is non-hazardous and meets CCME commercial or industrial guidelines.
- .2 Federal and provincial regulations will be adhered to for the export and import of fill and soil from the Work Site. For excess soil removed from the site, O. Reg 406/19 will be adhered to.
- .3 Excavated materials leaving the Work Site must be sampled by the Contractor and disposed of in accordance with provincial and federal standards.
 - .1 Parameters for excavated soil to be sampled are defined in part 9 of this Section. These parameters will be used for reuse of soil on the Work Site or disposal offsite.
 - .2 The Contractor will provide DCC with written documentation from the Receiving Site confirming that excess soil will be accepted at the facility based on the soil analytical results.
 - .3 The Contractor will provide the DCC Representative with copies of all manifests, weight tickets and waste hauler and disposal licenses.
- .4 All temporary stockpiled soil must be placed on an impermeable surface and covered with an impermeable, properly secured tarp.
 - .1 Temporary storage must be at least 31 meters away from sensitive receptors (e.g. waterbodies) and property boundaries.
 - .2 All stockpiles must be inspected on a regular schedule and maintained, as per the Soil Management Plan.
 - .3 Water contained in the stockpiled soil must be properly contained and managed to prevent contaminated water from running off into the environment.
- .5 Prevent disturbance and compaction of topsoil and underlying soil from vehicles and heavy equipment using load dispersion materials.

7 **Slurry Management**

- .1 To limit slurry production, air vacuum excavation and/or hand digging should be used whenever possible.
- .2 Soils to be removed from a known or suspected contaminated site by hydrovac must be characterized prior to removal.
- .3 If the soils in question contain (or are assumed to contain) PFAS, then hydrovac methods cannot be used unless a disposal option is determined prior to hydrovac.
- .4 If the slurry cannot be tested until after it's generated, then it must be temporarily stored in drums, tested, then disposed of according.

8 **Importing Fill Material**

- .1 All aggregate/fill materials imported onto DND property must be uncontaminated.
- .2 The Contractor is to confirm prior to importing fill material that there are no visual or olfactory indications of contamination.
- .3 All fill materials will require sampling and laboratory analysis, except the exempted materials listed below. These materials must be from a virgin source and not be recycled.
 - .1 Topsoil;
 - .2 Imported fill less than 10 m³;
 - .3 Gravel/aggregates larger than 2 mm (i.e. does not pass a US #10 sieve);
 - .4 Fines and materials generated by the mechanical activity of crushing virgin rock (i.e. crusher dust); or
 - .5 Gravel/aggregate material with less than 20% fines (US #10/ 2 mm sieve) by volume or mass.
- .4 The Contractor is to provide written justification from the Source Site identifying how the imported material is exempt from sampling.
- .5 All aggregate or fill materials not excluded, must be sampled under the supervision of a QP (as defined under the O. Reg 153/04) at the Source Site prior to coming onto DND lands.

- .6 Submit a letter report, as per section 5.3.3, stating that the imported fill material meets CCME Agricultural Land use criteria or acceptable ambient background conditions based on intended use.

9 Sampling and Test Results

- .1 Soil testing shall be conducted for imported fill, soil reuse on site and excess soil taken off site to identify soil quality conditions.
- .2 As part of the SMP, the Contractor is required to submit a Soil Sampling Plan that will detail the sampling and characterization of any excess soil to determine the location and concentration of contaminants to be removed from or imported to the work site that has not already been characterized within the contract documents.
 - .1 Sampling plan to be prepared as per MECP Rules of Soil Management and Excess Soil Quality Standards (s.3. pg.23).
 - .2 See Section 5.6 for minimum, mandatory Soil Sampling Plan content:
- .3 All samples are to be tested at a minimum for the following contaminant parameters:
 - 1. Polycyclic Aromatic Hydrocarbons (PAHs),
 - 2. Volatile Organic Compounds (VOCs),
 - 3. Petroleum Hydrocarbons (PHCs)
 - 4. Benzene, toluene, ethylbenzene, xylenes (BTEX)
 - 5. Metals and Inorganics.
 - 6. Per- and polyfluoroalkyl substances (PFAS)
- .4 Sampling for PFAS should include all parameters for which there are Federal criteria or guidelines.
- .5 Sampling frequencies will be in accordance with the MECP Rules of Soil Management and Excess Soil Quality Standards (s2, pg.18-19).

10 Unanticipated Soil Contamination

- .1 Refer to contract General Condition.
- .2 Should unanticipated soil contamination be discovered:
 - .1 Stop work and assess the situation for safety.
 - .2 If situation does not appear to be safe, evacuate workers from area.
 - .3 If safe to do so, take immediate steps to control any spread of contamination, in accordance with Contractor's spill response plan.

- .4 Immediately contact the DCC Representative for direction on how to proceed.

END OF SECTION

Part 1 GENERAL

1.1 RELATED SECTIONS

- .1 Section 01 33 00 - Submittal Procedures.
- .2 Section 01 45 00 - Quality Control.
- .3 Section 01 91 13 - General Commissioning (Cx) Requirements.
- .4 Section 01 91 13.13 - Commissioning Plan.

1.2 QUALITY MANAGEMENT SYSTEM

- .1 The Contractor shall adopt a documented Quality Management System to ensure that the specified quality standards for this project are achieved.
- .2 Purpose: Under the terms of the Contract, the Contractor is responsible for the delivery of a facility that meets the standards of quality demanded by the specification as it applies to materials, workmanship, and completed results. The purpose of the Contractor Quality Management System is to assist in the fulfillment of this obligation and to provide the DCC Representative with a means to confirm that the specified level of quality is being achieved.
- .3 Quality Management System: The Quality Management System (QMS) consists of the organizational structure and the inherent responsibilities, procedures, processes and resources needed to implement quality management of the building process. In addition, and for the purpose of this project, "Commissioning" will be considered an integral element of the quality management system. The QMS has three sub-systems as follows:
 - .1 Quality Assurance (QA): QA refers to the documented intent outlining the activities that are implemented in the QMS to provide confidence that the project will satisfy the relevant quality standards and specifications.
 - .2 Quality Control (QC): QC refers to the actual monitoring of specific project results to determine if they comply with relevant quality standards. There are a number of deliverables associated with the QC sub-system, most of these are generally already used on typical construction projects. The deliverables include, shop drawing reviews, on-site inspections and tests and related reports, site meeting minutes etc. In addition, the Commissioning Report is an important and integral element of the QC sub-system deliverables.
 - .3 Commissioning Plan (CP): Contractor commissioning Coordinator will participate in the preparation of the detailed commissioning plan in consultation with the mechanical, electrical and other subcontractors. The Commissioning Authority will require the contractor's contributions to be completed prior to the 60% completion of the construction work at the site.

1.3 ROLES AND RESPONSIBILITIES

- .1 There will be four key individuals (parts) in the project's Quality Management System. The DCC Representative, the Contractor's Project Manager, the Contractor's Quality Manager and the Contractor's Commissioning Coordinator. Their responsibilities and roles are defined as follows:
 - .1 The Project DCC Representative: The Project DCC Representative is the person appointed by Defence Construction Canada to act on their behalf in matters of contract issues and to ensure that the activities match the Contractors schedule and that the construction processes are in accordance with contract documents. The Project DCC

Representative is responsible to ensure that a Quality Management System has been established by the Contractor and that it will satisfy the quality objectives of the project as outlined in the specification. The Project DCC Representative will review and accept the Quality Management Plan and will appoint a Commissioning Agent to review the Commissioning Plan.

- .2 Contractor's Project Manager: The Contractor's Project Manager is responsible for developing and implementing an effective Quality Management System. This will cover the full spectrum of work with which the Contractor is involved during the contract period. The Contractor's Project Manager will demonstrate the existence of the Quality Management System by submitting a Quality Management Plan and appointing a Quality Manager.
- .3 Contractor's Quality Manager (QM): The Contractor shall appoint a Quality Manager for the project. The duties of the Quality Manager are independent of and play no role in the work production to which QA/QC activities are applied. The Quality Manager cannot be the project manager or the project supervisor. The Quality Manager shall be empowered to carry out duties and to require conformance to the quality standards and requirements of the Contract Documents.
 - .1 Will be responsible for:
 - .1 Day to day execution of the Quality Plan;
 - .2 Working with trade contractors to explain the nature of the Quality Plan, their role in it and ensuring quality workmanship on site;
 - .3 Maintaining Quality records on site including:
 - .1 inspections and test reports;
 - .2 non-conformance reports; and
 - .3 corrective action reports and sign offs.
 - .4 Facilitating quality inspections by the DCC Representative's representatives;
 - .5 Reporting to the Contractor Project Manager on the Quality Process for the project.
- .4 Contractor's Commissioning Coordinator: The Contractor's Commissioning Coordinator will be appointed by the contractor. The Coordinator's responsibilities will include the following:
 - .1 Actively participate in the preparation of the detailed commissioning plan;
 - .2 Assemble the contractor's commissioning team
 - .3 Coordinating the Contractor's team's input into the commissioning process;
 - .4 Coordinating the mechanical, electrical, controls, and other subcontractor's input into the commissioning process; and
 - .5 Execute the Commissioning Plan in consultation with the Commissioning Authority, DCC Representative, the Contractor's PM, and the Contractor's Quality Manager.

1.4 DELIVERABLES

- .1 Quality Management Plan: The Quality Management Plan will address quality assurance and quality control issues and serves as the guide to the quality related activities the Contractor will undertake over the course of the project. The plan will be delivered within 4 weeks after award. As a minimum, the plan will direct the following activity:

- .1 Implementing an active program to instill in management staff, design professionals, supervisory personnel and sub-contractors an awareness of the requirement for quality work and obtaining the commitment to produce it.
- .2 Assembling an experienced staff capable of performing good quality work and engaging sub-contractors capable of producing good quality work, for example:
 - .1 Perform Work in accordance with standard accepted industry practices for type of Work unless specifications stipulate more precise requirements.
 - .2 Do Work in neat and careful manner to retain Work plumb, square, and straight.
 - .3 Ensure Work is properly related to form close joints and appropriately aligned junctions, edges and surfaces and is free of warp, twist, wind, wave or other irregularities.
 - .4 When required by specifications or by manufacturers recommendations, have manufacturer, supplier or accredited agent, inspect work which incorporates their products.
 - .5 Do not permit materials to come in contact with other materials whether in presence of moisture or otherwise if conditions will result in corrosion, stain or discoloration or deterioration of completed Work. Provide compatible, durable separators where contact is unavoidable.
 - .6 When any of the above conditions are not met, the DCC Representative may require the Contractor to redo the work at no additional cost and with no additional construction time to the contract.
- .3 Establishing as-built drawing review to ensure that the construction requirements meet the specification and are understood by all project stakeholders. The documentation of these reviews shall form the auditable trail of change between the requirements in the specification with the construction documents.
- .4 Maintaining an effective shop drawing verification and approval system.
- .5 Establishing a system of inspection reports that demonstrate an active site inspection routine by the Contractor's team and the Quality Manager complete with a system of inspection reports.
 - .1 The Contractor's Quality Management Plan shall describe in detail proposed quality control practices. The Quality Management Plan shall:
 - .1 Identify items of work which will be subject to controls, and list particular checks and tests which are to be performed for each item of work,
 - .2 indicate frequency of checks, tests and milestones at which they are to be carried out, and
 - .3 provide for reports on results of these activities, with reports submitted to DCC Representative and Quality Auditor.
- .6 Consulting with supervisory personnel, workmen and sub-contractors to confirm that the requirements of the drawings and specification are thoroughly understood and executed.
- .7 Maintaining material ordering procedures and records that verify and confirm the materials purchased meet the specified standards.
- .8 Ensuring adequate materials and assembly testing procedures are in place throughout the project.
- .9 Verifying that the equipment which is to be used to perform the work is appropriate and in good working order.
- .10 Providing inspection services, in some cases by engaging specialist firms, of certain high risk installations, e.g. roofing, HVAC testing and balancing.

- .11 Providing an inspection framework to ensure conformance of work of one stage before the next stage is performed, for example:
 - .1 verifying that granular base material is compacted to the specified standards before placing reinforcing steel,
 - .2 verifying reinforcing steel installation for conformity to spec and accepted practice, before placing concrete,
 - .3 hydrostatic, pneumatic pressure testing prior to backfilling or closing in.
- .12 Providing mock-ups or sample sections of repetitive work to establish acceptable standard of workmanship e.g. concrete pavement sections, concrete block masonry and/or brickwork, roof curbing details etc.
- .13 Systems Commissioning as described in the Commissioning Plan.
- .14 The Contractor's Quality Manager will be responsible for all quality aspects on this contract. The contractor's responsibilities include the work activities carried out by Subcontractors, suppliers, manufacturers and fabricators working on behalf of the Contractor.
- .15 Implement the Quality Management Plan to organize, demonstrate and document the work is performed in accordance with the requirements of the Contract Documents.
- .16 Incorporate required inspection and testing of work by Contractor's subcontractors, suppliers and fabricators into the Quality Management Plan.
- .17 Incorporate documented Quality Program and procedures including provisions for equipment procurement, manufacture and installation, construction, testing, start-up, operational training and maintainability.
- .18 The following items must be addressed in the Contractor's Quality Control Plan:
 - .1 Management responsibilities,
 - .2 Quality Management organizational structure,
 - .3 Quality Management personnel,
 - .4 Integration of subcontractors, suppliers and fabricators quality programs with the Contractor's Quality Program,
 - .5 Documentation of the Contractor's Quality Program,
 - .6 Document control,
 - .7 Purchasing control,
 - .8 Product identification and traceability,
 - .9 Process control,
 - .10 Inspection and testing,
 - .11 Inspection, Measuring and Testing Equipment,
 - .12 Inspection and testing status,
 - .13 Standards of acceptance for mock-ups and testpanels where they are not identified by specifications,
 - .14 Non-conformance,
 - .15 Corrective/ preventative action,
 - .16 Quality records and;
 - .17 User training.
- .19 The Contractor's Quality Manager will carry out weekly inspections of all divisions of work on-site. The Quality Manager shall submit a written report within 2 working days of weekly inspections to the DCC Representative. The written reports shall identify work

completed in a particular division, any specific problems with the completed work, any non-conforming work, proposed corrective action and detailed notes pertaining to the quality of the installed works.

- .20 The Quality Management Plan shall be organized by NMS divisional format. Each division shall contain the following elements:
 - .1 Scope of the work subject to control and quality measures,
 - .2 Proposed quality control processes,
 - .3 Description of proposed Inspection and Testing activities and equipment,
 - .4 Standards of acceptance for results from inspection and testing activities,
 - .5 Specific Inspection forms and Checklists.
- .2 Commissioning Plan: The Commissioning Plan will be a separately bound volume of the Quality Management Plan. It will describe the commissioning activity, and address quality assurance and quality control issues related to the commissioning of building systems. The Commissioning Plan will be prepared by the Contractor's Commissioning Coordinator, in concert with the DCC Representative's Commissioning Agent, the Contractor's PM, Sub-contractors, and the DCC Representative.

The Plan will address the following items:

 - .1 The objectives of the commissioning process for this project.
 - .2 The general approach which will be taken to implement the commissioning of building systems.
 - .3 A description of the commissioning team (to include owner identified representatives and a brief terms of reference for the team members.
 - .4 A listing and description of the systems which are to be commissioned.
 - .5 A sequential listing of the commissioning activities and tests for each system and outline descriptions of each activity and test.
 - .6 A tentative schedule of the commissioning activities which will be refined throughout the contract period.
 - .7 A full commissioning plan, c/w with all test sheets and implementation schedule must be presented by the 60% completion of the construction work at the site.

All Contractor QA and QC activities on the Contract, as well as those QA and QC activities carried out by designers, consultants, sub consultants, trade contractors, suppliers, manufacturers and fabricators working on behalf of the Contractor may be subject to auditing by the DCC Representative. On notice of a quality audit the contractor will facilitate the audit activity by providing back up documentation and access to work areas.

1.5 QUALITY CONTROL REPORTS AND RETURNS

- .1 Site Services. QM to provide the following:
 - .1 Installation of site services to be approved by QM and DCC Representative.
 - .2 Weekly inspection by QM. Report to comment on joints, bedding, thrust blocks, slope, general workmanship.
 - .3 Hydrostatic testing certified by QM.
 - .4 Flushing and disinfecting certified by QM.
 - .5 Final certification of all structural fills, subgrade, proof rolling and granular fills by soils consultant.
- .2 Structural. QM to provide the following:

- .1 Inspection sign-off sheets for formwork, rebar and soils testing for each concrete pour by QM.
- .2 Inspection of soils during foundation installation by soils consultant.
- .3 Weekly inspection of foundation and other concrete work. Report to comment on rebar, and/or bolts, inserts, formwork concreting materials and methods and conformance to specification and drawings, as well as code requirements by QM. All concrete Quality Control testing to be provided and paid for by the Contractor.
- .4 Inspection and approval of cold weather concreting practices by QM during weekly inspections. Include form removal practices.
- .5 Structural steel mill test reports by QM.
- .6 Weekly inspection of structural steel installation by QM to certify conformance to specifications and drawings.
- .7 Inspection of bolt torque and weld by QM.
- .8 Structural weld radiography by QM. Radiography to be performed at manufacturers shop before arrival of steel on site. Percentage of welds to be tested to be per CSA Standard and as noted on the drawings and specified herein. A corrective action will be put in place in the event of non conforming welds, and will at a minimum consist of if a weld fails, adjacent welds are to be tested. If adjacent weld fails, 100% welds will be tested all at Contractors expense.
- .9 Certification by QM that all erectors, fabricators and welders are certified in accordance with the appropriate CSA standard.
- .3 Architectural. QM to provide the following:
 - .1 Masonry and mortar test reports.
 - .2 Pre-cast concrete test reports.
 - .3 Air barrier installation inspection. Provide reports.
 - .4 Inspection of insulation and vapour barrier. Approval by DCC Representative before cover-up.
 - .5 Inspection and approval of fireproofing and fire barriers by QM.
 - .6 Weekly site inspections by QM. Include report on overall conformance to specifications and drawings, quality, accuracy, alignments, levelness and plumbness.
- .4 Mechanical. QM to provide the following:
 - .1 Pressure tests of all underground and concealed piping. QM to certify.
 - .2 Weekly inspection and report on piping installations by QM.
 - .3 Inspection and report by QM that all plumbing clean-outs are installed such that the entire drainage system can be rodded.
 - .4 Inspection and report by QM on pipe hangers, hanger spacing and rod diameter.
 - .5 Inspection and report by QM on position of service valves. Certify that valves are oriented correctly.
 - .6 Inspection and report by QM on adequate service clearance being provided for mechanical equipment.
 - .7 Inspection and report by QM on isolation valves and unions being properly located for specific equipment.
 - .8 Inspection and report by QM on adequate headroom being provided.
 - .9 Inspection and report by QM on installation of expansion joints and flex connectors in piping system.

- .10 QM to inspect and report weekly on general installation conformance to specifications and drawings.
- .11 Inspection and report on ventilation air balancing work done by an independent specialized firm, QM to monitor
- .12 Inspection and report of Energy Monitoring of all controls systems by QM.
- .5 Electrical. QM to provide the following:
 - .1 QM to inspect and report weekly on general installation conformance to specifications and drawings.
 - .2 Conduct and pay for tests of the following:
 - .1 Power distribution system including phasing, voltage, grounding and load balancing.
 - .2 Circuits originating from branch distribution panels.
 - .3 Lighting systems and controls.
 - .4 Motors, heaters and associated control equipment including sequenced operation of systems where applicable.
 - .5 Systems: fire alarm system, communication systems.
 - .6 Testing and reporting of grounding systems.
 - .1 Power ground system.
 - .2 Telecommunication ground system.
 - .3 Carry out tests in presence of DCC Representative
 - .4 Provide instruments, meters, equipment and personnel required to conduct tests during and at conclusion of project.
 - .5 Test all systems in accordance with details in appropriate sections.
 - .6 Testing methods and test results: in accordance with CSA, CEC and regulations of the supply authority and other authorities having jurisdiction.
 - .7 Remove and replace with new materials all conductors that are found to be shorted or grounded.
 - .8 Conduct dielectric tests, hi-pot tests, insulation resistance tests and ground continuity tests as required by the nature of the various systems and equipment.
- .6 Fire Alarm System Testing and Adjusting. QM to provide the following:
 - .1 Ensure that the manufacturer makes an inspection of the fire alarm and smoke detection system and equipment. The inspection tests to conform to CAN/ULC-S537 Inspection and Testing of Fire Alarm System.
 - .2 On completion of the inspection and when all of the above conditions have been complied with, the manufacturer shall issue to the DCC Representative the following:
 - .1 A copy of the inspecting technician's report showing the location of each device and certifying the test results of each device.
 - .2 A certificate of verification confirming that the inspection has been completed and showing the conditions upon which such inspection and certification have been rendered.
 - .3 Proof of liability insurance for the inspection.
 - .3 The Canadian Forces Fire Marshal (CFFM) shall conduct commissioning testing following verification. A manufacturer's representative shall be present during the testing.
 - .4 The QM must be present at and during the verification and certification in order for the verification to be valid. The Contractor must furnish to the DCC Representative, prior to

verification, as-built drawings showing exact routing of all conduits, exact location of all devices including end-of-line devices and exact wire counts.

- .5 Provide weekly inspection reports by QM on general installation and conformance to specifications and drawings.
- .6 Specialized Equipment to be commissioned as per manufacturer's or supplier instruction and recommendation.

1.6 DCC REPRESENTATIVE QUALITY AUDIT

- .1 DCC Representative will arrange for Quality Audit during all phases of the Contract. DCC Representative may appoint Quality Audit Personnel to assist in conducting the audit. Contractor shall provide access to all areas of the Work and provide any assistance required by the DCC Representative or his appointed quality audit personnel to carry out quality audit.
- .2 DCC Representative's Quality Audit Process will be a series of activities, which will permit the DCC Representative to ascertain that Work is being performed in accordance with the drawings and specifications, contractor's Quality Control Program and all applicable codes and standards.
- .3 The Audit process will enable the DCC Representative to monitor quality control and quality assurance mechanisms which are in place, and to request any adjustment to quality control or quality assurance processes, should such adjustments become necessary. The Audit process will allow the DCC Representative to verify, on a continuing basis, that an appropriate Quality Management System is in place and being implemented effectively.
- .4 The Quality Audit Personnel appointed by the DCC Representative will investigate and evaluate the work and contractor's degree of compliance with the project requirements. The Quality Audit Personnel may perform up to three different types of audit during the course of the project:
 - .1 Targeted Audit to attain assurance that the critical requirements have been met;
 - .2 Random Audits to provide assessment of the contractor's performance in satisfying the contractual, performance and quality requirements of the work;
 - .3 Monitoring Audits to investigate the compliance of possible non-conformance observed by the DCC Representative's representatives in the course of their other duties.

Part 2 PRODUCTS

2.1 NOT USED

- .1 Not Used.

Part 3 EXECUTION

3.1 NOT USED

- .1 Not Used.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

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

1.2 INSPECTION

- .1 Allow DCC Representative and DND technical authority 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 DCC 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 DCC Representative may order any part of Work to be examined if Work is suspected to be not in accordance with Contract Documents. If, upon examination such work is found not in accordance with Contract Documents, correct such Work and pay cost of examination and correction. If such Work is found in accordance with Contract Documents, DCC Representative shall pay cost of examination and replacement.

1.3 INDEPENDENT INSPECTION AGENCIES

- .1 Independent Inspection/Testing Agencies will be engaged by DCC Representative for purpose of inspecting and/or testing portions of Work. Cost of such services will be borne by DCC Representative.
- .2 Employment of inspection/testing agencies does not relax responsibility to perform Work in accordance with Contract Documents.
- .3 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 DCC Representative at no cost to DCC Representative. Pay costs for retesting and re-inspection.

1.4 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.

1.5 PROCEDURES

- .1 Notify appropriate agency and DCC Representative in advance of requirement for tests, in order that attendance arrangements can be made.
- .2 Submit samples and/or materials required for testing, as specifically requested in specifications. Submit with reasonable promptness and in orderly sequence to not cause delays in Work.
- .3 Provide labour and facilities to obtain and handle samples and materials on site. Provide sufficient space to store and cure test samples.
- .4 Carry out work using qualified licensed workers or apprentices in accordance with Provincial Act. Permit employees registered in Provincial apprenticeship program to perform specific tasks only if under direct supervision of qualified licensed workers.

1.6 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 DCC 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 DCC Representative it is not expedient to correct defective Work or Work not performed in accordance with Contract Documents, DCC Representative 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 DCC Representative.

1.7 REPORTS

- .1 Submit electronic copies of inspection and test reports to DCC Representative.
- .2 Provide copies to subcontractor of work being inspected or tested manufacturer or fabricator of material being inspected or tested.

1.8 TESTS AND MIX DESIGNS

- .1 Furnish test results and mix designs as requested.
- .2 Cost of tests and mix designs beyond those called for in Contract Documents or beyond those required by law of Place of Work will be appraised by DCC Representative and may be authorized as recoverable.

1.9 MOCK-UPS

- .1 Prepare mock-ups for Work specifically requested in specifications. Include for Work of Sections required to provide mock-ups.
- .2 Construct in locations acceptable to DCC Representative.

- .3 Prepare mock-ups for DCC Representative's review with reasonable promptness and in orderly sequence, to not cause delays in Work.
- .4 Failure to prepare mock-ups in ample time is not considered sufficient reason for extension of Contract Time and no claim for extension by reason of such default will be allowed.
- .5 If requested, DCC Representative will assist in preparing schedule fixing dates for preparation.

1.10 MILL TESTS

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

1.11 EQUIPMENT AND SYSTEMS

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

Part 2 Products

2.1 NOT USED

- .1 Not Used.

Part 3 Execution

3.1 NOT USED

- .1 Not Used.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

- .1 Section 01 52 00 – Construction Facilities.
- .2 Section 01 56 00 – Temporary Barriers and Enclosures.

1.2 INSTALLATION AND REMOVAL

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

1.3 TEMPORARY HEATING AND VENTILATION

- .1 Provide temporary heating required during construction period, including attendance, maintenance and fuel.
- .2 Construction heaters used inside building must be vented to outside or be flameless (vent free) type. Solid fuel salamanders are not permitted.
- .3 Provide temporary heat and ventilation in enclosed areas as required to:
 - .1 Facilitate progress of Work.
 - .2 Protect Work and products against dampness and cold.
 - .3 Prevent moisture condensation on surfaces.
 - .4 Provide ambient temperatures and humidity levels for storage, installation and curing of materials.
 - .5 Provide adequate ventilation to meet health regulations for safe working environment.
- .4 Maintain temperatures of minimum 10 degrees Celsius in areas where construction is in progress.
- .5 Ventilating:
 - .1 Prevent accumulations of dust, fumes, mists, vapours or gases in areas occupied during construction.
 - .2 Provide local exhaust ventilation to prevent harmful accumulation of hazardous substances into atmosphere of occupied areas.
 - .3 Dispose of exhaust materials in manner that will not result in harmful exposure to persons.
 - .4 Ventilate storage spaces containing hazardous or volatile materials.
 - .5 Ventilate temporary sanitary facilities.
 - .6 Continue operation of ventilation and exhaust system for time after cessation of work process to assure removal of harmful contaminants.
- .6 Permanent heating system of building, to be used when available. Be responsible for damage to heating system if use is permitted.

- .7 On completion of Work for which permanent heating system is used, replace filters, and clean HVAC units and duct work.
- .8 Be responsible for damage to Work due to failure in providing adequate heat and protection during construction.

1.4 TEMPORARY POWER AND LIGHT

- .1 Connect to existing power supply in accordance with Canadian Electrical Code.
- .2 Electrical power and lighting systems installed under this Contract may be used for construction requirements only with prior approval of DCC Representative provided that guarantees are not affected. Make good damage to electrical system caused by use under this Contract
- .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 lines necessary for own use.

1.6 FIRE PROTECTION

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

Part 2 Products

2.1 NOT USED

- .1 Not Used.

Part 3 Execution

3.1 NOT USED

- .1 Not Used.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

- .1 Section 01 51 00 – Temporary Facilities.
- .2 Section 01 56 00 – Temporary Barriers and Enclosures.

1.2 INSTALLATION AND REMOVAL

- .1 Prepare site plan indicating proposed location and dimensions of area to be fenced and used by Contractor, number of trailers to be used, avenues of ingress/egress to fenced area and details of fence installation.
- .2 Identify areas which have to be gravelled to prevent tracking of mud.
- .3 Indicate use of supplemental or other staging area.
- .4 Provide construction facilities in order to execute work expeditiously.
- .5 Remove from site all such work after use.

1.3 SCAFFOLDING

- .1 Provide and maintain scaffolding, ramps and ladders.
- .2 Scaffolding in accordance with CAN/CSA-S269.2.

1.4 HOISTING

- .1 Provide, Operate and maintain cranes required for moving workers, materials, and equipment.
- .2 Cranes shall be operated by a qualified operator.
- .3 All crane operations shall comply with WSO 23-10.

1.5 ELEVATORS

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

1.6 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 a weight or force that will endanger the Work.

1.7 CONSTRUCTION PARKING

- .1 Three parking spots will be permitted on site, additional parking provided south of Highway 2.
- .2 Provide and maintain adequate access to project site.
- .3 Use existing roads for access to project site. Make good damage resulting from Contractors' use of roads.

1.8 OFFICES

- .1 Provide site trailer heated to 22degrees C, lighted 750lx 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 Subcontractors to provide their own offices as necessary.
- .4 Allocate space for when DCC Representative visits site.
- .5 Maximum of three trailers on site. Confirm location with DCC Representative.

1.9 EQUIPMENT TOOLS AND MATERIALS STORAGE

- .1 Provide and maintain, in a 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 a manner to cause least interference with work activities.

1.10 SANITARY FACILITIES

- .1 Provide sanitary facilities for work force in accordance with governing regulations and ordinances.
- .2 Post notices and take such precautions as required by local health authorities. Keep area and premises in sanitary condition.

1.11 CONSTRUCTION SIGNAGE

- .1 Construction signs to be placed in locations designated by DCC Representative.
- .2 Signs and notices for safety and instruction shall be in both official languages. Graphic symbols shall conform to CAN3-Z321.
- .3 Maintain approved signs and notices in good condition for duration of project and dispose of off-site on completion of project.

1.12 PROTECTION AND MAINTENANCE OF TRAFFIC

- .1 Provide access and temporary relocated roads as necessary to maintain traffic.

- .2 Maintain and protect traffic on affected roads during construction period except as otherwise specifically directed by DCC Representative.
- .3 Provide measures for protection and diversion of traffic, including provision of watchpersons and flag-persons, erection of barricades, placing of lights around and in front of equipment and work, and erection and maintenance of adequate warning, danger, and direction signs.
- .4 Protect travelling public from damage to person and property.
- .5 Contractor's traffic on roads selected for hauling material to and from site to interfere as little as possible with public traffic.
- .6 Verify adequacy of existing roads and allowable load limit on these roads. Contractor: responsible for repair of damage to roads caused by construction operations.
- .7 Construct access and haul roads necessary.
- .8 Haul roads: constructed with suitable grades and widths; sharp curves, blind corners, and dangerous cross traffic shall be avoided.
- .9 Provide necessary lighting, signs, barricades, and distinctive markings for safe movement of traffic.
- .10 Dust control: adequate to ensure safe operation at all times.
- .11 Location, grade, width, and alignment of construction and hauling roads: subject to approval by DCC Representative.
- .12 Lighting: to assure full and clear visibility for full width of haul road and work areas during night work operations.
- .13 Provide snow removal during period of Work.
- .14 Remove, upon completion of work, haul roads designated by DCC Representative.

1.13 CLEAN-UP

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

Part 2 Products

2.1 NOT USED

- .1 Not Used.

Part 3 Execution

3.1 NOT USED

.1 Not Used.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

- .1 Section 01 51 00 – Temporary Utilities.
- .2 Section 01 52 00 – Construction Facilities.

1.2 INSTALLATION AND REMOVAL

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

1.3 HOARDING

- .1 Erect temporary site enclosures using 38 x 89 mm construction grade lumber framing at 600 mm centres and 1200 x 2400 x 13 mm exterior grade fir plywood to CSA O121.
- .2 Apply plywood panels vertically flush and butt jointed.

1.4 GUARD RAILS AND BARRICADES

- .1 Provide secure, rigid guard rails and barricades around deep excavations, open shafts, open stair wells, open edges of floors and roofs.
- .2 Provide as required by governing authorities.

1.5 WEATHER ENCLOSURES

- .1 Provide weather tight closures to unfinished door and window openings, tops of shafts and other openings in floors and roofs.
- .2 Close off floor areas where walls are not finished; seal off other openings; enclose building interior work for temporary heat.
- .3 Design enclosures to withstand wind pressure and snow loading.

1.6 DUST TIGHT SCREENS

- .1 Provide dust tight screens or 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.

1.7 ACCESS TO SITE

- .1 Maintain access roads, sidewalk crossings, as may be required for access to Work.

1.8 FIRE ROUTES

- .1 Maintain access to property including overhead clearances for use by emergency response vehicles.
- .2 Provide yellow marker tape to restrict DND personnel from traversing work area.

1.9 PROTECTION FOR OFF-SITE AND PUBLIC PROPERTY

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

1.10 PROTECTION OF BUILDING FINISHES

- .1 Provide protection for finished and partially finished building finishes and equipment during performance of Work.
- .2 Provide necessary screens, covers, and hoardings.
- .3 Be responsible for damage incurred due to lack of or improper protection.

Part 2 Products

2.1 NOT USED

- .1 Not used.

Part 3 Execution

3.1 NOT USED

- .1 Not used.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

- .1 Section 01 45 00 – Quality Control.

1.2 REFERENCE STANDARDS

- .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 any product or system is in conformance with applicable standards, DCC Representative reserves the right to have such products or systems tested to prove or disprove conformance.
- .4 Costs for such testing will be born by DCC Representative in event of conformance with Contract Documents or by Contractor in event of non-conformance.
- .5 Conform to latest date of issue of referenced standards in effect on date of submission of Tenders, except where specific date or issue is specifically noted.

1.3 QUALITY

- .1 Products, materials, equipment and articles (referred to as products throughout specifications) incorporated in Work shall be new, not damaged or defective, and of best quality (compatible with specifications) for purpose intended. If requested, furnish evidence as to type, source and quality of products provided.
- .2 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.
- .3 Should any dispute arise as to quality or fitness of products, decision rests strictly with DCC Representative based upon requirements of Contract Documents.
- .4 Unless otherwise indicated in specifications, maintain uniformity of manufacture for any particular or like item throughout building.
- .5 Permanent labels, trademarks and nameplates on products are not acceptable in prominent locations, except where required for operating instructions, or when located in mechanical or electrical rooms.

1.4 AVAILABILITY

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

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

1.6 TRANSPORTATION

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

1.7 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 DCC Representative in writing, of conflicts between specifications and manufacturer's instructions, so that DCC Representative may establish course of action.
- .3 Improper installation or erection of products, due to failure in complying with these requirements, authorizes DCC Representative to require removal and re-installation at no increase in Contract Price or Contract Time.

1.8 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 DCC 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. DCC 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 DCC Representative, whose decision is final.

1.9 CO-ORDINATION

- .1 Ensure cooperation of workers in laying out Work. Maintain efficient and continuous supervision.
- .2 Contractor shall coordinate installation of Work with all trades. Anticipate potential space restrictions prior to installation and ensure that placement of one trades work does not exclude or interfere with placement of work of other trades.

1.10 CONCEALMENT

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

1.11 REMEDIAL WORK

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

1.12 LOCATION OF FIXTURES

- .1 Inform DCC Representative of conflicting location of fixtures, outlets, and mechanical and electrical items. Install as directed.

1.13 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.

1.14 FASTENINGS - EQUIPMENT

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

1.15 PROTECTION OF WORK IN PROGRESS

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

1.16 EXISTING UTILITIES

- .1 When breaking into or connecting to existing services or utilities, execute Work at times directed by local governing authorities, with minimum of disturbance to Work, and/or building occupants and pedestrian and vehicular traffic.
- .2 Protect, relocate or maintain existing active services. When services are encountered, cap off in manner approved by authority having jurisdiction. Stake and record location of capped service.

1.17 PRODUCTS

- .1 Contractors options for selection of materials for bidding:
 - .1 Materials specified by referenced standard, select any material that meets or exceeds the specified standard.
 - .2 Materials specified by "Prescriptive" or "Performance" specification, select any material meeting or exceeding specification.
 - .3 Materials specified by naming one or more materials, select any material named. For the purpose of these specifications, the term "Acceptable Material" is deemed to be a complete and working commodity as described by a manufacturer's name, catalogue number, trade name or any combination thereof.
 - .4 When materials are specified by a Standard, Prescriptive or Performance specification, upon request of the DCC Representative, obtain from manufacturer an independent testing laboratory reporting, showing that the material or equipment meets or exceeds the specified requirements.
 - .5 The design and drawings are based upon the acceptable materials or products. The acceptable materials or products may not be identified in all aspects. A later claim by the

Contractor for an addition to the contract price because of changes to work necessitated by use of acceptable materials or products shall not be considered.

Part 2 Products

2.1 NOT USED

.1 Not used.

Part 3 Execution

3.1 NOT USED

.1 Not used.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

- .1 Section 01 77 00 – Closeout Procedures.

1.2 PROJECT CLEANLINESS

- .1 Maintain Work in tidy condition, free from accumulation of waste products and debris.
- .2 Remove waste materials from site at daily regularly scheduled times or dispose of as directed by DCC Representative. Do not burn waste materials on site.
- .3 Make arrangements with and obtain permits from authorities having jurisdiction for disposal of waste and debris.
- .4 Provide on-site containers for collection of waste materials and debris.
- .5 Provide and use marked separate bins for recycling.
- .6 Dispose of waste materials and debris off site.
- .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.
- .2 Remove waste products and debris and leave Work clean and suitable for occupancy.
- .3 Make arrangements with and obtain permits from authorities having jurisdiction for disposal of waste and debris.
- .4 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.

- .5 Remove stains, spots, marks and dirt from decorative work, electrical and mechanical fixtures, furniture fitments, walls, and floors.
- .6 Clean lighting reflectors, lenses, and other lighting surfaces.
- .7 Vacuum clean and dust building interiors, behind grilles, louvres and screens.
- .8 Wax, seal, shampoo or prepare floor finishes, as recommended by manufacturer.
- .9 Inspect finishes, fitments and equipment and ensure specified workmanship and operation.
- .10 Broom clean and wash exterior walks, steps and surfaces; rake clean other surfaces of grounds.
- .11 Remove dirt and other disfiguration from exterior surfaces.
- .12 Clean and sweep roofs, gutters, areaways, and sunken wells.
- .13 Sweep and wash clean paved areas.
- .14 Clean equipment and fixtures to sanitary condition; replace filters of mechanical equipment.
- .15 Clean roofs, downspouts, and drainage systems.
- .16 Remove debris and surplus materials from crawl areas and other accessible concealed spaces.

1.4 WASTE MANAGEMENT AND DISPOSAL

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

Part 2 Products

2.1 NOT USED

- .1 Not Used.

Part 3 Execution

3.1 NOT USED

- .1 Not Used.

END OF SECTION

Part 1 General

1.1 DEFINITIONS

- .1 Clean Waste: Untreated and unpainted; not contaminated with oils, solvents, sealants or similar materials.
- .2 Construction and Demolition Waste: Solid wastes typically including building materials, packaging, trash, debris, and rubble resulting from construction, re modeling, and demolition operations.
- .3 Hazardous: Exhibiting the characteristics of hazardous substances including properties such as ignitability, corrosiveness, toxicity or reactivity.
- .4 Non hazardous: Exhibiting none of the characteristics of hazardous substances, including properties such as ignitability, corrosiveness, toxicity, or reactivity.
- .5 Non toxic: Not poisonous to humans either immediately or after a long period of exposure.
- .6 Recyclable: The ability of a product or material to be recovered at the end of its life cycle and remanufactured into a new product for reuse by others.
- .7 Recycle: To remove a waste material from the project site to another site for remanufacture into a new product for reuse by others.
- .8 Recycling: The process of sorting, cleansing, treating and reconstituting solid waste and other discarded materials for the purpose of using the altered form; recycling does not include burning, incinerating, or thermally destroying waste.
- .9 Return: To give back reusable items or unused products to vendors for credit.
- .10 Reuse: To reuse a construction waste material in some manner on the project site.
- .11 Salvage: To remove a waste material from the project site to another site for resale or reuse by others.
- .12 Sediment: Soil and other debris that has been eroded and transported by storm or well production run off water.
- .13 Source Separation: The act of keeping different types of waste materials separate beginning from the first time they become waste.
- .14 Toxic: Poisonous to humans either immediately or after a long period of exposure.
- .15 Trash: Any product or material unable to be reused, returned, recycled, or salvaged.
- .16 Volatile Organic Compounds (VOC's): Chemical compounds common in and emitted by many building products over time through outgassing:
 - .1 Solvents in paints and other coatings;

- .2 Wood preservatives; strippers and household cleaners;
 - .3 Adhesives in particleboard, fiberboard, and some plywood; and foam insulation.
 - .4 When released, VOC's can contribute to the formation of smog and can cause respiratory tract problems, headaches, eye irritations, nausea, damage to the liver, kidneys, and central nervous system, and possibly cancer.
- .17 Waste: Extra material or material that has reached the end of its useful life in its intended use. Waste includes salvageable, returnable, recyclable, and reusable material.

1.2 MATERIALS SOURCE SEPARATION PROGRAM

- .1 Provide on-site facilities for collection, handling, and storage of anticipated quantities of reusable and recyclable materials.
- .2 Provide containers to deposit reusable and recyclable materials.
- .3 Locate containers in locations, to facilitate deposit of materials without hindering daily operations.
- .4 Locate separated material(s) in area(s) which minimize material damage.
- .5 Collect, handle, store on-site, and transport off-site, salvaged materials in separate condition.

1.3 STORAGE, HANDLING AND PROTECTION

- .1 Store/stockpile materials to be reused, recycled and salvaged in locations as directed by DCC Representative.
- .2 Unless specified otherwise, materials for removal become Contractor's property.
- .3 Separate non-salvageable materials from salvaged items. Transport and deliver non-salvageable items to licensed disposal facility.
- .4 Protect surface drainage, mechanical and electrical from damage and blockage.

1.4 DISPOSAL OF WASTES

- .1 Do not bury rubbish or waste materials.
- .2 Do not dispose of waste into waterways, storm, or sanitary sewers.
- .3 Dispose of all waste materials off-site at licensed facility in accordance with appropriate provincial and municipal regulations.
- .4 Keep records of construction waste including:
 - .1 Number and size of bins.
 - .2 Waste type of each bin.
 - .3 Total tonnage generated.
 - .4 Tonnage reused or recycled.
 - .5 Reused or recycled waste destination.

Part 2 Products

2.1 NOT USED

- .1 .1 Not Used.

Part 3 Execution

3.1 APPLICATION

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

3.2 CLEANING

- .1 Remove tools and waste materials on completion of Work and leave work area in clean and orderly condition.
- .2 Clean up work area as work progresses.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

- .1 Section 01 78 00 – Closeout Submittals.
- .2 Section 01 91 13 – General Commissioning (Cx) Requirements.

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 DCC Representative in writing of satisfactory completion of Contractor's inspection and submit verification that corrections have been made.
 - .2 Request DCC Representative's inspection.
 - .2 DCC Representative's Inspection:
 - .1 DCC Representative and Contractor to inspect Work and identify defects and deficiencies.
 - .2 Contractor to correct Work as directed.
 - .3 Completion Tasks: submit written certificates that tasks have been performed as follows:
 - .1 Work: completed and inspected for compliance with Contract Documents.
 - .2 Defects: corrected and deficiencies completed.
 - .3 Equipment and systems: tested, adjusted, balanced and fully operational.
 - .4 Certificates required by Fire Commissioner and Utility companies: submitted.
 - .5 Operation of systems: demonstrated to Owner's personnel.
 - .6 Commissioning of mechanical systems: completed in accordance with 01 91 13 - GENERAL COMMISSIONING REQUIREMENTS and 01 91 13.13 - COMMISSIONING PLAN and copies of final Commissioning Report submitted to DCC Representative.
 - .4 Final Inspection:
 - .1 When completion tasks are done, request final inspection of Work by DCC Representative, and Contractor.
 - .2 When Work incomplete according to DND and DCC Representative, complete outstanding items and request reinspection.
- .2 Declaration of Substantial Performance: when DND and DCC Representative consider deficiencies and defects have been corrected and it appears requirements of Contract have been substantially performed, make application for certificate of Substantial Performance.
- .3 Commencement Warranty Periods: date of DND's acceptance of submitted declaration of Substantial Performance shall be date for commencement for warranty period.
- .4 Final Payment: When DND and DCC Representative consider final deficiencies and defects have been corrected and it appears requirements of Contract have been totally performed, make

application for final payment. If Work is deemed incomplete by DND and DCC Representative, complete outstanding items and request re-inspection.

Part 2 Products

2.1 NOT USED

.1 Not Used.

Part 3 Execution

3.1 NOT USED

.1 Not Used.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

- .1 Section 01 45 00 – Quality Control.
- .2 Section 01 77 00 – Closeout Procedures.
- .3 Section 01 91 13 – General Commissioning (Cx) Requirements.

1.2 ADMINISTRATIVE REQUIREMENTS

- .1 Pre-warranty Meeting:
 - .1 Convene meeting one week prior to contract completion with contractor's representative and DCC Representative, in accordance with Section 01 31 19 - Project Meetings to:
 - .1 Verify Project requirements.
 - .2 Review warranty requirements.
 - .2 DCC 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 weeks prior to Substantial Performance of the Work, submit to the DCC Representative, four final copies and an electronic copy 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 in the form of an instructional manual.
- .2 Binders: vinyl, hard covered, 3 'D' ring, loose leaf 219 x 279 mm with spine and face pockets, filled no more than 2/3rds full.
- .3 When multiple binders are used, correlate data into related consistent groupings. 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 or process flow, 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. Bind in with text; fold larger drawings to size of text pages.
- .9 Provide one copy of the operating and maintenance manuals in digital

1.5 CONTENTS – PROJECT RECORD DOCUMENTS

- .1 Table of Contents: provide title of project;
 - .1 Date of submission; names,
 - .2 Addresses, and telephone numbers of Consultant and Contractor with name of responsible parties;
 - .3 Schedule of products and systems, indexed to content of volume.
- .2 For each product or system:
 - .1 List names, addresses and telephone numbers of subcontractors and suppliers, including local source of supplies and replacement parts.
- .3 Product Data: mark each sheet to clearly 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. Provide logical sequence of instructions for each procedure, incorporating manufacturer's instructions specified in Section 01 45 00 - Quality Control.

1.6 AS -BUILT DOCUMENTS AND SAMPLES

- .1 In addition to requirements in General Conditions, maintain at the site for DCC 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. 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. Label each document "PROJECT RECORD" in neat, large, printed letters.
- .4 Maintain record documents in clean, dry and legible condition. Do not use record documents for construction purposes.
- .5 Keep record documents and samples available for inspection by DCC Representative.

1.7 RECORDING ACTUAL SITE CONDITIONS

- .1 Contractor shall maintain during construction two sets of white prints for record drawing purposes. Record changes and at completion of project submit one marked copy to the DCC Representative.
- .2 Use felt tip marking pens, maintaining separate colours for each major system, for recording information.
- .3 Record information concurrently with construction progress. Do not conceal Work until required information is recorded.
- .4 Contract Drawings and shop drawings: legibly 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 and addenda.
 - .6 Details not on original Contract Drawings.
 - .7 References to related shop drawings and modifications.
- .5 Specifications: legibly mark each item to record actual construction, including:
 - .1 Manufacturer, trade name, and catalogue number of each product actually installed, particularly optional items and substitute items.
 - .2 Changes made by Addenda and change orders.
- .6 Other Documents: maintain manufacturer's certifications, inspection certifications, field test records, required by individual specifications sections.
- .7 At completion of project, transfer recorded changes to Construction Drawings and submit as-built drawings to DCC Representative. DCC Representative will furnish copy of original construction drawings in electronic format. As built drawing submissions shall include one (1) marked copy of the Construction Drawings, one (1) hard copy of the As-built drawings and one (1) copy of As-built drawings in electronic format: AutoCad 2004 or later. All drawings shall be submitted and marked As-Built.

- .8 Provide digital photographs, if requested by DCC representative. DND/DCC to confirm process for photos in this area.

1.8 EQUIPMENT AND SYSTEMS

- .1 Each item of equipment and each system: include description of unit or system, and component parts. Give function, normal operation characteristics, and limiting conditions.
 - .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 coordination drawings, with installed colour coded piping diagrams.
- .12 Provide charts of valve tag numbers, with location and function of each valve, keyed to flow and control diagrams.
- .13 Provide list of original manufacturer's spare parts, current prices, and recommended quantities to be maintained in storage.
- .14 Additional requirements: As specified in individual specification sections.

1.9 MATERIALS AND FINISHES

- .1 Building Products, Applied Materials, and Finishes: include product data, with catalogue number, size, composition, and colour and texture designations.

- .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 STORAGE, HANDLING AND PROTECTION

- .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 to satisfaction of DCC Representative.

1.11 WARRANTIES AND BONDS

- .1 Develop warranty management plan to contain information relevant to Warranties.
- .2 Submit warranty management plan, 30 days before planned prewarranty conference, to DCC Representative for approval.
- .3 Warranty management plan to include required actions and documents to assure that DCC 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 DCC 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 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 11 month warranty inspection, measured from time of acceptance, by DCC 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, pumps, motors, and commissioned systems such as fire protection, alarm systems, and sprinkler systems.
 - .3 Provide list for each warranted equipment, item, feature of construction or system indicating:
 - .1 Name of item.
 - .2 Model and serial numbers.
 - .3 Location where installed.
 - .4 Name and phone numbers of manufacturers or suppliers.
 - .5 Names, addresses and telephone numbers of sources of spare parts.
 - .6 Warranties and terms of warranty: include one-year overall warranty of construction. Indicate items that have extended warranties and show separate warranty expiration dates.
 - .7 Cross-reference to warranty certificates as applicable.
 - .8 Starting point and duration of warranty period.
 - .9 Summary of maintenance procedures required to continue warranty in force.
 - .10 Cross-Reference to specific pertinent Operation and Maintenance manuals.
 - .11 Organization, names and phone numbers of persons to call for warranty service.
 - .12 Typical response time and repair time expected for various warranted equipment.
 - .4 Contractor's plans for attendance at 11 month postconstruction 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 DCC Representative to proceed with action against Contractor.

1.12 WARRANTY TAGS

- .1 Tag, at time of installation, each warranted item. Provide durable, oil and water resistant tag approved by DCC 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

2.1 NOT USED

- .1 Not Used.

Part 3 Execution

3.1 NOT USED

- .1 Not Used.

END OF SECTION

Part 1 General

1.1 ADMINISTRATIVE REQUIREMENTS

- .1 Demonstrate Operation and maintenance of equipment and systems to Owner's personnel two weeks prior to date of substantial performance completion.
- .2 Owner: provide list of personnel to receive instructions, and coordinate their attendance at agreed-upon times.
- .3 Preparation:
 - .1 Verify conditions for demonstration and instructions comply with requirements.
 - .2 Verify designated personnel are present.
 - .3 Ensure equipment has been inspected and put into operation.
 - .4 Ensure testing, adjusting, and balancing has been performed in accordance with Section 01 91 13 - GENERAL COMMISSIONING REQUIREMENTS and equipment and systems are fully operational.
- .4 Demonstration and Instructions:
 - .1 Demonstrate start-up, operation, control, adjustment, troubleshooting, servicing, and maintenance of each item of equipment at agreed upon times, at the equipment location.
 - .2 Instruct personnel in phases of operation and maintenance using operation and maintenance manuals as basis of instruction.
 - .3 Review contents of manual in detail to explain aspects of operation and maintenance.
 - .4 Prepare and insert additional data in operations and maintenance manuals when needed during instructions.
- .5 Time Allocated for Instructions: ensure amount of time required for instruction of each item of equipment or system as follows:
 - .1 Section 21 05 00/21 30 00 – Fire Protection Systems: 8 hours of instruction.
 - .2 Section 23 34 23.13 - Cooling and Ventilation System: 1 hour of instruction.
 - .3 Section 23 82 39.23 – Heating System: 0.5 hour of instruction
 - .4 Section 25 01 11 - Control System: 4 hours of instruction.
 - .5 Section 22 05 15 - Plumbing System: 0.5 hour of instruction.
 - .6 Section 26 05 00 - Electrical System: 4 hours of instruction.
 - .7 Section 13 34 19 - Overhead Doors: 0.5 hours of instruction.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Submit schedule of time and date for demonstration of each item of equipment and each system two weeks prior to designated dates, for DCC Representative's approval.
- .3 Submit reports within one week after completion of demonstration, that demonstration and instructions have been satisfactorily completed.

- .4 Give time and date of each demonstration, with list of persons present.
- .5 Provide copies of completed operation and maintenance manuals for use in demonstrations and instructions.

1.3 QUALITY ASSURANCE

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

Part 2 Products

2.1 NOT USED

- .1 Not Used.

Part 3 Execution

3.1 NOT USED

- .1 Not Used.

END OF SECTION

Part 1 General

1.1 SUMMARY

.1 Acronyms:

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

1.2 GENERAL

- .1 Cx is a planned program of tests, procedures and checks carried out systematically on systems and integrated systems of the finished Project. Cx is performed after systems and integrated systems are completely installed, functional and Contractor's Performance Verification responsibilities have been completed and approved. Objectives:

- .1 Verify installed equipment, systems and integrated systems operate in accordance with Contract Documents and design criteria and intent.
- .2 Ensure appropriate documentation is compiled into the BMM.
- .3 Effectively train O&M staff.

- .2 Contractor assists in Cx process, operating equipment and systems, troubleshooting and making adjustments as required.

- .1 Systems to be operated at full capacity under various modes to determine if they function correctly and consistently at peak efficiency. Systems to be interactively with each other as intended in accordance with Contract Documents and design criteria.
- .2 During these checks, adjustments to be made to enhance performance to meet environmental or user requirements.
- .3 Design Criteria: as per client's requirements or determined by designer. To meet Project functional and operational requirements.

1.3 COMMISSIONING OVERVIEW

- .1 Section 01 91 13.13 - Commissioning Plan.
- .2 For Cx responsibilities refer to Section 01 91 13.13 - Commissioning Plan.
- .3 Cx to be a line item of Contractor's cost breakdown.
- .4 Cx activities supplement field quality and testing procedures described in relevant technical sections.

- .5 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.
- .6 DCC Representative will issue Substantial completion when:
 - .1 Completed Cx documentation has been received, reviewed for suitability and approved by DCC 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 DCC 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 Confirm all Cx requirements with DCC Representative.
 - .2 Review Contract Documents, confirm by writing to DCC 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.
 - .2 Before start of Cx:
 - .1 Have completed Cx Plan up-to-date.
 - .2 Ensure installation of related components, equipment, subsystems, 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 DCC 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 DCC Representative for review and approval.

- .10 Ensure "As-Built" system schematics are available.
- .11 Inform DCC 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 DCC 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 DCC Representative for changes to submittals and obtain written approval at least 8 weeks prior to start of Cx.
 - .3 Submit proposed Cx procedures to DCC 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 DCC Representative.

1.8 COMMISSIONING DOCUMENTATION

- .1 DCC Representative to review and approve Cx documentation.
- .2 Provide completed and approved Cx documentation to DCC Representative.

1.9 COMMISSIONING SCHEDULE

- .1 Provide detailed Cx schedule as part of construction schedule in accordance with Section 01 32 16.19 - Construction Progress Schedule - Bar (GANTT) Chart.
- .2 Provide adequate time for Cx activities prescribed in technical sections and commissioning sections including:
 - .1 Approval of Cx reports.
 - .2 Verification of reported results.
 - .3 Repairs, retesting, re-commissioning, re-verification.
 - .4 Training.

1.10 COMMISSIONING MEETINGS

- .1 Convene Cx meetings following project meetings: Section 01 32 16.19 - Construction Progress Schedule - Bar (GANTT) Chart and as specified herein.

- .2 Purpose: to resolve issues, monitor progress, identify deficiencies, relating to Cx.
- .3 Continue Cx meetings on regular basis until commissioning deliverables have been addressed.
- .4 At 60% construction completion stage. Section 01 32 16.19 - Construction Progress Schedule - Bar (GANTT) Chart. DCC 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 commissioning process.
- .5 Thereafter Cx meetings to be held until project completion and as required during equipment start-up and functional testing period.
- .6 Meeting will be chaired by Contractor, who will record and distribute minutes.
- .7 Ensure subcontractors and relevant manufacturer representatives are present at 60% and subsequent Cx meetings and as required.

1.11 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 days notice prior to commencement.
- .2 DCC Representative to witness of 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 DCC Representative.
 - .3 Arrange for DCC Representative to witness tests.
 - .4 Obtain written approval of test results and documentation from DCC 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 DCC 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.

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 finetuning.
- .3 Correct deficiencies and obtain approval from DCC Representative after distinct phases have been completed and before commencing next phase.
- .4 Document require tests on approved PV forms.
- .5 Failure to follow accepted start-up procedures will result in re-evaluation of equipment by an independent testing agency selected by DCC 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 DCC Representative.
 - .2 Major equipment/systems: if evaluation report concludes that damage is minor, implement corrective measures approved by DCC Representative.
 - .3 If evaluation report concludes that major damage has occurred, DCC Representative shall reject equipment.
 - .1 Rejected equipment to be remove from site and replace with new.
 - .2 Subject new equipment/systems to specified start-up procedures.
- .6 The commissioning of the works shall consist of the following as a minimum, supplemented as detailed in individual specification sections and by the requirements of the equipment manufacturer and the commissioning agent's commissioning plan.
- .7 System verifications:
 - .1 Perform system pressure testing and provide written confirmation of pressures achieved. Refer to 23 05 05 Installation of Pipework.
 - .2 Perform underground piping pressure testing and provide pressure testing reports.
 - .3 Perform water makeup backflow preventer testing and verification before permanently opening water flow to water storage tank. Provide backflow preventer test report.

- .4 Fill piping system. Perform system flushing, cleaning and replace pump strainers. Refer to 23 08 02 Cleaning and Start-up of Mechanical Piping Systems.
- .5 Provide written report of completion of tank leak testing.
- .6 Fill water storage tank. Verify operation of water level indicators. Verify water mixer operation and provide report. Verify immersion heater operation and provide report including amperage draw and initial and final tank water temperature after 1 hour of continuous output.
- .7 Perform continuity and megger testing of water line heat tracing and provide report of results.
- .8 Perform fuel storage tank and fuel piping system leak testing and provide TSSA report certifying fuel oil system before filling fuel tanks.
- .8 Perform equipment startups as follows:
 - .1 Bump jockey pump and verify rotation, amp draw. Provide pump startup checklist completed by manufacturer's qualified representative. Verify pressure sensor input to jockey pump controller. Refer to 21 30 00 Fire pumps and NFPA 20.
 - .2 Perform fire pump startups according to NFPA 20.
 - .1 With fire pump discharge isolated and recirculation to water tank open, bump each fire pump by setting the discharge pressure switch to below setpoint.
 - .2 Verify pump engines engage.
 - .3 Verify pump engine operation, temperature, oil pressure, discharge water pressure, intake water pressure, water flow.
 - .4 Verify pressure sensor input to fire pump controller.
 - .5 Verify relief valve operation and record settings.
 - .6 Provide written startup report signed by manufacturer's certified representative.
 - .3 Verify enclosure heater operation by raising thermostat setpoint above room temperature.
 - .4 Provide ESA report of fire pump enclosure electrical systems.
 - .5 Perform fire alarm system verification of all supervised valves and alarm initiating and indicating devices.
- .9 Perform whole system functional performance testing as follows:
 - .1 Open discharge valve to hangar sprinkler system.
 - .2 Open sprinkler system test valve and exterior system testing discharge points to simulate fire flow demand.
 - .3 Verify that fire pump pressure sensors detect drop in pressure and engage lead fire pumps only.
 - .4 Verify that fire alarm system detects signal from fire pump controller and outputs alarm to base fire department.
 - .5 Record fire pump intake and discharge pressure, flow.
 - .6 Record water flow at hangar test discharge.
 - .7 Record water level change in water storage tank.
 - .8 Disengage pumps and return fire pump system and hangar sprinkler system to normal operation by refilling hangar sprinkler piping system, refilling water storage tank, resetting alarms.
 - .9 Perform test of UPS by turning off main normal power supply.
 - .10 Verify lead/lag switchover of pumps.
 - .11 Provide all startup, inspection, verification reports in the operation and maintenance manual.
- .10 Perform demonstration and operator training of complete system, using the completed operation and maintenance manual. Training to identify:

- .1 Locations of all equipment isolation valves and power sources and procedures for shutdown and re-energizing equipment.
- .2 List of manufacturer-recommended maintenance activities and frequency of maintenance for major equipment such as boilers, pumps, unit heaters.
- .3 Locations of all strainers, air vents, control valves, balancing valves and piping system drain down points.
- .4 All operator passwords for equipment with electronic screens.
- .5 Location of spare parts.
- .6 Location of valve chart and system schematics.

1.15 START-UP DOCUMENTATION

- .1 Assemble start-up documentation and submit to DCC 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 DCC 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 DCC 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 substantial completion.

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 DCC 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 DCC Representative for review and approval:
 - .1 Complete list of instruments proposed to be used.
 - .2 Listed data including, serial number, current calibration certificate, calibration date, calibration expiry date and calibration accuracy.
- .2 Provide the following equipment as required:
 - .1 2-way radios.
 - .2 Ladders.
 - .3 Equipment as required to complete work.

1.20 COMMISSIONING PERFORMANCE VERIFICATION

- .1 Carry out Cx:
 - .1 Under accepted simulated 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 DCC 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 DCC Representative within 5 days of test and with Cx report.

1.23 COMMISSIONING CONSTRAINTS

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

1.26 REPEAT VERIFICATIONS

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

1.27 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.

1.28 DEFICIENCIES, FAULTS, DEFECTS

- .1 Correct deficiencies found during start-up and Cx to satisfaction of DCC Representative.
- .2 Report problems, faults or defects affecting Cx to DCC Representative in writing. Stop Cx until problems are rectified. Proceed with written approval from DCC 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 79 00 - Demonstration and Training.

1.31 MAINTENANCE MATERIALS, SPARE PARTS, SPECIAL TOOLS

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

1.32 OCCUPANCY

- .1 Cooperate fully with DCC 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 DCC Representative.
- .2 Calibrated EMCS sensors may be used to obtain performance data provided that sensor calibration has been completed and accepted.

1.34 PERFORMANCE VERIFICATION TOLERANCES

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

1.35 OWNER'S PERFORMANCE TESTING

- .1 Performance testing of equipment or system by DCC 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.

CMMS Equipment Inventory Data Sheet		
PART 1	System Equipment	Component
GENERAL INFORMATION		
Equipment Description		Life Support
		Yes No
Area Served:	Area:	Room #:
PART 2		
MANUFACTURER INFORMATION		Manufacturer Name:
Model Number:		Serial Number:
Local Agent Name:		Phone #: Fax #:
Local Agent Address:		
PART 3		
WARRANTY INFORMATION		Start End Date:
Date:		
Special Warranty Terms and Conditions:		
PART 4		
EQUIPMENT DETAILS		
<i>Electrical Specifications</i>		<i>Mechanical Specifications</i>
Horsepower:		Belts:
Voltage:		Sheaves:
Ampacity:		Pre-Filter Specs:
Phase:		Final Filter Specs:
Frame:		Bearing (front/left)
Service Factor:		Bearing (back/right)
OTHER INFORMATION:		

END OF SECTION

Part 1 General

1.1 GENERAL

- .1 Provide a fully functional system:
 - .1 Systems, equipment, and components meet user's functional requirements before date of acceptance and operate consistently at peak efficiencies, and within specified energy budgets under normal loads.
 - .2 Facility user and O&M personnel have been fully trained in aspects of installed systems.
 - .3 Optimized life cycle costs.
 - .4 Complete documentation relating to installed equipment and systems.
- .2 Term "Cx" in this Section means "Commissioning".
- .3 Use this Cx Plan as Master Planning Document for Cx:
 - .1 Outlines organization, scheduling, allocation of resources, documentation, pertaining to implementation of Cx.
 - .2 Communicates responsibilities of team members involved in Cx Scheduling, documentation requirements, and verification procedures.
 - .3 Sets out deliverables relating to O&M, process, and administration of Cx.
 - .4 Describes process of verification of how built works meet design requirements.
 - .5 Produces a complete functional system prior to issuance of Certificate of Occupancy.
 - .6 Management tool that sets out scope, standards, roles and responsibilities, expectations, deliverables, and provides:
 - .1 Overview of Cx.
 - .2 General description of elements that make up Cx Plan.
 - .3 Process and methodology for successful Cx.
- .4 Acronyms:
 - .1 BMM - Building Management Manual.
 - .2 Cx - Commissioning.
 - .3 EMCS - Energy Monitoring and Control Systems.
 - .4 PI - Product Information.
 - .5 PV - Performance Verification.
 - .6 TAB - Testing, Adjusting and Balancing.
 - .7 WHMIS Safety Data Sheets (SDS).
 - .8 WHMIS - Workplace Hazardous Materials Information System.
- .5 Commissioning terms used in this Section:
 - .1 Bumping: Short-term start-up to prove ability to start and prove correct rotation.
 - .2 Deferred Cx - Cx activities delayed for reasons beyond Contractor's control due to lack of occupancy, weather conditions, need for heating/cooling loads.

1.2 DEVELOPMENT OF 100% CX PLAN

- .1 Cx Plan to be 100% completed within eight (12) weeks of award of Contract to consider:
 - .1 Approved Shop Drawings and product data.

- .2 Approved changes to Contract.
- .3 Contractor's project schedule.
- .4 Cx schedule.
- .5 Contractor's, sub-contractor's, and suppliers' requirements.
- .6 Project construction team's and Cx team's requirements.
- .2 Submit completed Cx Plan to DCC Representative and obtain written approval.

1.3 REFINEMENT OF CX PLAN

- .1 During construction phase, revise, refine and update Cx Plan to include:
 - .1 Changes resulting from Client program modifications.
 - .2 Approved design and construction changes.
- .2 Revise, refine and update every 2 months during construction phase. At each revision, indicate revision number and date.
- .3 Submit each revised Cx Plan to DCC Representative for review and obtain written approval.
- .4 Include testing parameters at full range of operating conditions and check responses of equipment and systems.

1.4 COMPOSITION, ROLES, AND RESPONSIBILITIES OF CX TEAM

- .1 DCC Representative to maintain overall responsibility for project and is sole point of contact between members of Cx team.
- .2 Project Manager will select Cx Team consisting of following members:
 - .1 DCC Representative is responsible for:
 - .1 Organizing Cx.
 - .2 Monitoring operations Cx activities.
 - .3 Witnessing, certifying accuracy of reported results.
 - .4 Witnessing and certifying TAB and other tests.
 - .5 Developing BMM.
 - .6 Ensuring implementation of final Cx Plan.
 - .7 Implementation of Training Plan.
 - .2 Construction Team: Contractor, subcontractors, suppliers, and support disciplines, are responsible for construction/installation in accordance with Contract Documents, including:
 - .1 Testing.
 - .2 TAB.
 - .3 Performance of Cx activities.
 - .4 Delivery of training and Cx documentation.
 - .5 Assigning one (1) person as point of contact with DCC Representative for administrative and coordination purposes.
 - .3 Contractor's Cx agent implements specified Cx activities including:
 - .1 Monitoring operations Cx activities.
 - .2 Performing verification of performance of installed systems and equipment.
 - .3 Demonstrations.
 - .4 Training.

- .5 Testing.
- .6 Preparation, submission of test reports.
- .4 Property Manager: Represents lead role in Operation Phase and onwards and is responsible for:
 - .1 Receiving facility.
 - .2 Day-To-Day operation and maintenance of facility.

1.5 CX PARTICIPANTS

- .1 Employ the following Cx participants to verify performance of equipment and systems:
 - .1 Installation Contractor/Subcontractor:
 - .1 Equipment and systems except as noted.
 - .2 Equipment Manufacturer: Equipment specified to be installed and started by manufacturer.
 - .1 To include performance verification.
 - .3 Specialist Subcontractor: Equipment and systems supplied and installed by specialist subcontractor.
 - .4 Specialist Cx Agency:
 - .1 Possessing specialist qualifications and installations providing environments essential to Client's program but are outside scope or expertise of Cx specialists on this project.
 - .5 Client: Responsible for intrusion and access security systems.
 - .6 Ensure that Cx participant:
 - .1 Could complete Work within scheduled time frame.
 - .2 Available for emergency and troubleshooting service during first year of occupancy by user for adjustments and modifications outside responsibility of O&M personnel, including:
 - .1 Modify ventilation rates to meet changes in off-gassing.
 - .2 Changes to heating or cooling loads beyond scope of EMCS.
 - .3 Changes to EMCS control strategies beyond level of training provided to O&M personnel.
 - .4 Redistribution of electrical services.
 - .5 Modifications of fire alarm systems.
 - .6 Modifications to voice communications systems.
 - .7 Provide names of participants to DCC Representative and details of instruments and procedures to be followed for Cx three (3) months prior to starting date of Cx for review and approval.

1.6 EXTENT OF CX

- .1 Cx Structural and Architectural Systems:
 - .1 Architectural and structural:
 - .1 Accessibility and operational safety:
 - .2 Doors, windows, related hardware:
 - .1 New door and window hardware.
 - .2 Commission mechanical systems and associated equipment:
 - .1 Plumbing systems:

- .1 Domestic.
 - .2 Regular sanitary waste systems.
 - .2 HVAC and exhaust systems:
 - .1 HVAC systems Div 23.
 - .2 Heating systems
 - .3 Fire and life safety systems:
 - .1 Special fire suppression systems identified herein:
 - .1 Fire pumps, including transfer switches and controllers.
 - .2 Wet pipe sprinkler systems.
 - .3 Fire extinguishers.
 - .4 Jockey pumps.
 - .5 Fuel oil storage and transfer systems.
 - .4 Noise and vibration control systems for mechanical systems.
 - .5 Seismic restraint and control measures.
 - .6 EMCS:
 - .1 Div 25.
- .3 Commission electrical systems and equipment:
 - .1 Low voltage below 750 V:
 - .1 Low voltage equipment.
 - .2 Low voltage distribution systems.
 - .3 Voice communications systems.
 - .4 Electronic data and communications information systems.
 - .2 Emergency power generation systems:
 - .1 Uninterruptible power systems.
 - .3 Lighting systems:
 - .1 Lighting equipment.
 - .2 Distribution systems.
 - .3 Emergency lighting systems, including battery packs.
 - .4 Fire exit emergency signage.
 - .4 Fire alarm systems, equipment:
 - .1 Annunciators.
 - .2 Control panels.
 - .3 Fire alarm battery banks.
 - .5 Other systems and equipment:
 - .1 Intrusion and access security and safety systems
 - .2 Lightning protection systems.

1.7 DELIVERABLES RELATING TO O&M PERSPECTIVES

- .1 General Requirements:
 - .1 Compile English documentation.
 - .2 Documentation to be computer-compatible format ready for inputting for data management.

- .2 Provide deliverables:
 - .1 Warranties.
 - .2 Project record documentation.
 - .3 Inventory of spare parts, special tools, and maintenance materials.
 - .4 Maintenance Management System (MMS) identification system used.
 - .5 WHMIS information.
 - .6 WHMIS Safety Data Sheets (SDS).
 - .7 Electrical panel inventory containing detailed inventory of electrical circuitry for each panel board. Duplicate of inventory inside each panel.

1.8 DELIVERABLES RELATING TO THE CX PROCESS

- .1 General:
 - .1 Start-up, testing, and Cx requirements, conditions for acceptance and specifications form part of relevant technical Sections of these Specifications.
- .2 Definitions:
 - .1 Cx as used in this Section includes:
 - .1 Cx of components, equipment, systems, subsystems, and integrated systems.
 - .2 Factory inspections and performance verification tests.
- .3 Deliverables: Provide:
 - .1 Cx Specifications.
 - .1 Startup, pre-Cx activities, and documentation for systems and equipment.
 - .2 Completed installation checklists (ICL).
 - .3 Completed Product Information (PI) report forms.
 - .4 Completed Performance Verification (PV) report forms.
 - .5 Results of Performance Verification Tests and Inspections.
 - .6 Description of Cx activities and documentation.
 - .7 Description of Cx of integrated systems and documentation.
 - .8 Tests performed by DCC Representative.
 - .9 Training Plans.
 - .10 Cx Reports.
 - .11 Prescribed activities during warranty period.
- .4 DCC Representative to witness and certify tests and reports of results provided to DCC Representative.
- .5 DCC Representative to participate.

1.9 PRE-CX ACTIVITIES AND RELATED DOCUMENTATION

- .1 Items listed in this Cx Plan include the following:
 - .1 Pre-Start-Up inspections: By DCC Representative prior to permission to start-up and rectification of deficiencies to DCC Representative's satisfaction;
 - .2 DCC Representative to use approved checklists;
 - .3 DCC Representative will monitor all pre-start-up inspections;
 - .4 Include completed documentation with Cx report;

- .5 Conduct pre-start-up tests: Conduct pressure, static, flushing, cleaning, and "bumping" during construction, as specified in Technical Sections. To be witnessed and certified by DCC Representative and does not form part of Cx specifications;
- .6 DCC Representative will monitor some of these inspections and tests;
- .7 Include completed documentation in Cx report.
- .2 Pre-Cx activities - ARCHITECTURAL AND STRUCTURAL:
 - .1 Slab and beam deflection test: test after removal of temporary supports and concrete has cured to ensure adequacy for raised floors.
 - .2 Exterior walls: conduct thermographic surveys to ensure appropriate level of tightness after exterior envelope has been completed. Permanent HVAC systems are able to provide appropriate negative or positive pressure, a temperature of at 20 degrees C can be maintained between inside and outside and wind speed is less than 10 kph.
 - .3 Doors, windows, related hardware:
 - .1 Door and window hardware: Div 13.
 - .4 Pre-Cx activities - MECHANICAL:
 - .1 Plumbing systems:
 - .1 "Bump" each item of equipment in its "stand-alone" mode.
 - .2 Complete pre-start-up checks and complete relevant documentation.
 - .3 After equipment has been started, test related systems in conjunction with control systems on a system-by-system basis.
 - .2 HVAC equipment and systems:
 - .1 "Bump" each item of equipment in its "stand-alone" mode.
 - .2 At this time, complete pre-start-up checks and complete relevant documentation.
 - .3 After equipment has been started, test related systems in conjunction with control systems on a system-by-system basis.
 - .4 Perform TAB on systems. TAB reports to be approved by DCC Representative.
 - .3 EMCS:
 - .1 EMCS trending to be available as supporting documentation for performance verification.
 - .2 Perform point-by-point testing in parallel with start-up.
 - .3 Carry out point-by-point verification.
 - .4 Demonstrate performance of systems, to be witnessed by DCC Representative prior to start of 30 day Final Acceptance Test period.
 - .5 Perform final Cx and operational tests during demonstration period and 30 day test period.
 - .6 Only additional testing after foregoing have been successfully completed to be "Off-Season Tests".
 - .4 Pre-Cx activities - LIFE SAFETY SYSTEMS
 - .1 Include equipment and systems identified above.
 - .1 Fire pump startup to NFPA 20.
 - .2 Reports of test results to be witnessed and certified by DCC Representative before verification.
 - .5 Pre-Cx activities - ELECTRICAL:

- .1 Low voltage distribution systems under 750 V:
 - .1 Requires independent testing agency to perform preenergization and post-energization tests.
- .2 Emergency power generation systems
 - .1 Transfer switches: test by simulating loss of power. Verify availability of power at equipment requiring same.
 - .2 Uninterruptible power systems: test under full and partial load conditions.
- .3 Lighting systems:
 - .1 Emergency lighting systems:
 - .1 Tests to include verification of lighting levels and coverage, initially by disrupting normal power.
- .4 Fire alarm systems: test after other safety and security systems are completed. Testing to include a complete verification in accordance with ULC requirements. DCC Representative has witnessed and certified report, demonstrate devices and zones to DCC Representative.
- .5 Low voltage systems: these include:
 - .1 low voltage lighting control systems and data communications systems.
- .6 Lightning protection systems.

1.10 START-UP

- .1 Start up components, equipment, and systems.
- .2 Equipment manufacturer, supplier, installing specialist sub-contractor, as appropriate, to start-up, under Contractor's direction, following equipment and systems:
 - .1 Fire pumps and controllers.
 - .2 Fuel oil storage and transfer.
 - .3 Fire alarm system.
- .3 DCC Representative to monitor all start-up activities.
 - .1 Rectify start-up deficiencies to satisfaction of DCC Representative.
- .4 Performance Verification (PV):
 - .1 Approved Cx Agent to perform.
 - .1 Repeat when necessary until results are acceptable to DCC Representative.
 - .2 Use procedures modified generic procedures to suit project requirements.
 - .3 DCC Representative to witness and certify reported results using approved PI and PV forms.
 - .4 DCC Representative to approve completed PV reports and provide to DCC Representative.
 - .5 DCC Representative reserves right to verify up to 100% of reported results at random.
 - .6 Failure of randomly selected item shall result in rejection of PV report or report of system start-up and testing.

1.11 CX ACTIVITIES AND RELATED DOCUMENTATION

- .1 Perform Cx by specified Cx agency using procedures developed by DCC Representative and approved by DCC Representative.
- .2 DCC Representative to monitor Cx activities.
- .3 Upon satisfactory completion, Cx agency performing tests to prepare Cx Report using approved PV forms.
- .4 DCC Representative to witness, certify reported results of Cx activities, and forward to DCC Representative.
- .5 DCC Representative reserves right to verify a percentage of reported results at no cost to Contract.

1.12 CX OF INTEGRATED SYSTEMS AND RELATED DOCUMENTATION

- .1 Cx to be performed by specified Cx specialist, using procedures developed and approved by DCC Representative.
- .2 Tests to be witnessed by DCC Representative and documented on approved report forms.
- .3 Upon satisfactory completion, Cx specialist to prepare Cx Report, to be certified by DCC Representative, and submitted to DCC Representative for review.
- .4 DCC Representative reserves right to verify percentage of reported results.
- .5 Integrated systems to include:
 - .1 Fire pump and controllers, hangar sprinklers, alarms
 - .2 HVAC and associated systems forming part of integrated HVAC systems: Exhaust and air intake.
 - .3 Environmental space conditions: Space heaters.
 - .4 Fire alarm systems
 - .5 Fire pumps and controllers.
 - .6 Emergency lighting systems.
- .6 Identification:
 - .1 In later stages of Cx, before hand-over and acceptance DCC Representative, Contractor, and Cx Manager to co-operate to complete inventory data sheets and provide assistance to DCC Representative in full implementation of MMS identification system of components, equipment, sub-systems, systems.

1.13 DELIVERABLES RELATING TO ADMINISTRATION OF CX

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

1.14 CX SCHEDULES

- .1 Prepare detailed Cx Schedule and submit to DCC Representative for review and approval same time as project Construction Schedule. Include:
 - .1 Milestones, testing, documentation, training and Cx activities of components, equipment, subsystems, systems and integrated systems, including:
 - .1 Design criteria, design intents.

- .2 Pre-TAB review: 28 days after contract award, and before construction starts.
- .3 Cx agents' credentials: 60 days before start of Cx.
- .4 Cx procedures: 3 months after award of contract.
- .5 Cx Report format: 3 months after contract award.
- .6 Discussion of heating/cooling loads for Cx: 3 months before start-up.
- .7 Submission of list of instrumentation with relevant certificates: 21 days before start of Cx.
- .8 Notification of intention to start TAB: 21 days before start of TAB.
- .9 TAB: after successful start-up, correction of deficiencies and verification of normal and safe operation.
- .10 Notification of intention to start Cx: 14 days before start of Cx.
- .11 Notification of intention to start Cx of integrated systems: after Cx of related systems is completed 14 days before start of integrated system Cx.
- .12 Identification of deferred Cx.
- .13 Implementation of training plans.
- .14 Cx reports: immediately upon successful completion of Cx.
- .15 Emergency evacuation exercises: after 80% occupancy and at same time as Cx of stair shaft pressurization systems.
- .2 Detailed training schedule to demonstrate no conflicts with testing, completion of project and hand-over to Property Manager.
- .2 After approval, incorporate Cx Schedule into Construction Schedule.
- .3 Consultant, Contractor, Contractor's Cx agent, and DCC Representative will monitor progress of Cx against this schedule.

1.15 CX REPORTS

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

1.16 ACTIVITIES DURING WARRANTY PERIOD

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

1.17 FINAL SETTINGS

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

Part 2 Products

2.1 NOT USED

.1 Not Used.

Part 3 Execution

3.1 NOT USED

.1 Not Used.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 02 41 13.13 - Paving Removal
- .2 Section 31 23 33.01 - Excavating, Trenching and Backfilling

1.2 REFERENCE STANDARDS

- .1 Canadian Environmental Assessment Act (CEAA), 2012
- .2 Canadian Environmental Protection Act (CEPA), 2012
 - .1 SOR/2003-2, On-Road Vehicle and Engine Emission Regulations
 - .2 SOR/2006-268, Regulations Amending the On-Road Vehicle and Engine Emission Regulations
 - .3 Transportation of Dangerous Goods Act (TDGA), 1992, c. 34
 - .4 Motor Vehicle Safety Act (MVSA), 1995
 - .5 Hazardous Materials Information Review Act, 1985
- .3 Ontario Water Resources Act
 - .1 R.R.O. 1990, Regulation 903, Wells

1.3 DEFINITIONS

- .1 Selective Demolition: Sequencing demolition activities to allow separation and sorting of selected site materials.
- .2 Hazardous Substances: dangerous substances, dangerous goods, hazardous commodities and hazardous products, including but not limited to: asbestos, PCB's, CFC's, HCFC's poisons, corrosive agents, flammable substances, ammunition, explosives, radioactive substances, or other material that can endanger human health or well being or environment if handled improperly.

1.4 ADMINISTRATIVE REQUIREMENTS

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Scheduling: meet project timelines without compromising specified minimum rates of material diversion.
 - .1 Notify DCC Representative in writing when unforeseen delays occur.

1.5 QUALITY ASSURANCE

- .1 Regulatory Requirements: ensure Work, hauling and disposal is performed in compliance with regulations of Authority Having Jurisdiction.

1.6 DELIVERY, STORAGE AND HANDLING

- .1 Storage and Protection.
 - .1 Protect in accordance with Section 31 23 33.01 - Excavating, Trenching and Backfilling.
 - .2 Protect existing items designated to remain and items designated for salvage. In event of damage to such items, immediately replace or make repairs to approval of DCC Representative and at no additional cost.
 - .3 Remove and store materials to be salvaged, in manner to prevent damage.

- .4 Store and protect in accordance with requirements for maximum preservation of material.
- .5 Handle salvaged materials as new materials.

1.7 SITE CONDITIONS

- .1 Environmental protection:
 - .1 Ensure Work does not adversely affect adjacent watercourses, groundwater and wildlife, or contribute to excess air and noise pollution.
 - .2 Fires and burning of waste or materials is not permitted on site.
 - .3 Burying of rubbish waste materials is not permitted.
 - .4 Disposal of waste of volatile materials including but not limited to, mineral spirits, oil, petroleum based lubricants, or toxic cleaning solutions into watercourses, storm or sanitary sewers, is not permitted.
 - .5 Ensure proper disposal procedures are maintained throughout the project.
- .2 Pumping of water containing suspended materials into watercourses, storm or sanitary sewers or onto adjacent properties, is not permitted.
- .3 Control disposal or runoff of water containing suspended materials or other harmful substances as directed by the DCC Representative.
- .4 Protect trees, plants and foliage on site and adjacent properties where indicated.
- .5 Cover or wet down dry materials and waste to prevent blowing dust and debris. Control dust on all temporary roads.
- .6 Conduct selective site demolition so operations will not be disrupted:
 - .1 Provide not less than 72 hours' notice to DCC Representative of activities that will affect operations.
 - .2 Maintain access to all buildings and properties
- .7 Before selective site demolition, remove, protect and store salvaged items as directed by DCC Representative:
 - .1 Salvage items as identified by DCC Representative.

1.8 HAZARDOUS MATERIALS

- .1 Hazardous materials will be as defined in the Hazardous Materials Act.
- .2 If materials suspected of containing hazardous materials are encountered, do not disturb; immediately notify DCC Representative. Any hazardous materials will be removed by under a separate contract or as a change to the Work.

Part 2 Products

2.1 EQUIPMENT

- .1 Equipment and Heavy Machinery:
 - .1 Machinery running only while in use, except where extreme temperatures prohibit shutting machinery down.

Part 3 Execution

3.1 EXAMINATION

- .1 Survey existing conditions and correlate with requirements indicated to determine extent of selective site demolition required.
- .2 Inspect site with DCC Representative and verify extent and location of items designated for removal, disposal, alternative disposal, recycling, salvage and items to remain.
 - .1 Inventory and record the condition of items being removed and salvaged.

3.2 PREPARATION

- .1 Permits and Notifications:
 - .1 Obtain "Digging Permit".
 - .2 Notify and obtain approval of utility companies before starting demolition.
- .2 Temporary Erosion and Sedimentation Control:
 - .1 Provide temporary erosion and sedimentation control measures.
- .3 Protection of in-place conditions:
 - .1 Prevent movement, settlement or damage of adjacent structures, services, paving, trees, landscaping, adjacent grades, properties to remain.
 - .1 Provide bracing, shoring and underpinning as required.
 - .2 Repair damage caused by demolition as directed by DCC Representative at no additional cost.
 - .2 Prevent debris from blocking surface drainage systems which must remain in operation.
 - .3 Protect existing water wells and monitoring wells located outside of immediate construction zone during construction activities.
- .4 Surface Preparation:
 - .1 Electrical and service lines within the site.
 - .1 Post warning signs on electrical lines and equipment which must remain energized to serve other properties during period of selective site demolition.
 - .2 Disconnect and cap designated services.
 - .1 Sanitary Sewer and Storm Sewer: remove as indicated and as directed by DCC Representative.
 - .2 Other underground services: remove and dispose of as indicated and as directed by DCC Representative.
 - .3 Disruption of active or energized utilities designated to remain undisturbed is not permitted.

3.3 REMOVAL AND DEMOLITION OPERATIONS

- .1 Remove items as indicated.
- .2 Disruption of items designated to remain in place is not permitted.
- .3 Removal of Hazardous Materials:
 - .1 If encountered, remove hazardous, contaminated or dangerous materials defined by authorities having jurisdiction, relating to environmental protection, from base property and dispose of in safe manner to minimize danger at site or during disposal.
- .4 Removal of asphalt pavements: in accordance with Section 02 41 13.13 – Paving Removal

- .5 Removal of concrete pavements.
 - .1 Saw cut to neat lines at edge of proposed construction limit
 - .2 Remove and dispose of offsite, concrete pavement and reinforcing steel
- .6 Excavate at least 150mm below pipe invert, when removing pipes under existing or future pavement area.
- .7 Salvage:
 - .1 Items to be salvaged include: any item deemed desirable for salvage by the DCC Representative.
 - .2 Dismantle items containing materials for salvage and stockpile salvaged materials at locations as determined by the DCC Representative.
- .8 Disposal of Material:
 - .1 Material to be reused at existing site where possible.
 - .2 Excess material to be disposed of offsite.
 - .1 Dispose of materials not designated for salvage or reuse off base property at an approved waste facility.
- .9 Backfill: Backfill in areas as indicated and in accordance with Section 31 23 33.01 - Excavating, Trenching and Backfilling.

3.4 STOCKPILING

- .1 Locate stockpiled materials convenient for use in new construction to eliminate double handling wherever possible.
 - .1 Contractor to obtain written approval from DCC Representative for all stockpiling locations.
- .2 Protect stockpiled materials from weather elements as necessary.
- .3 Stockpile materials designated for alternate disposal in location which facilitates removal from site and examination by potential end markets, and which does not impede disassembly, processing, or hauling procedures.

3.5 REMOVAL FROM SITE

- .1 Remove stockpiled material as directed by DCC Representative, when it interferes with operations of project.
- .2 Dispose of materials not designated for alternate disposal off base in accordance with applicable regulations.

3.6 RESTORATION

- .1 Restore areas and existing works outside areas of demolition to match condition of adjacent, undisturbed areas.

3.7 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.
 - .1 Leave Work area clean at end of each day.
 - .2 Remove debris, trim surfaces and leave work site clean, upon completion of Work
 - .3 Use cleaning solutions and procedures which are not harmful to health, are not injurious to plants, and do not endanger wildlife, adjacent water courses or ground water.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 02 41 13.13 - Selective Site Demolition

1.2 REFERENCE STANDARDS

- .1 Canadian Environmental Assessment Act (CEAA), 1995, c. 37.
- .2 Canadian Environmental Protection Act, 1999 (CEPA), c. 33.

1.3 SITE CONDITIONS

- .1 Protect existing site features to remain or identified for salvage or re use; make repairs and restore to a similar condition to existing where damage to these items occurs as directed by DCC Representative and at no additional cost:
 - .1 Remove and store salvaged materials to prevent contamination.
 - .2 Store and protect salvaged materials as required for maximum preservation of material.
 - .3 Handle salvaged materials same as new materials.
- .2 Protect existing site features and structures, trees, plants and foliage on site and adjacent properties.

Part 2 Products

2.1 EQUIPMENT

- .1 Asphalt can be removed utilizing cold milling, planning, grinding or excavation equipment, with the capability of removing part of pavement surface to depths or grades indicated.

Part 3 Execution

3.1 PREPARATION

- .1 Verify extent and location of asphalt identified for removal, disposal, alternative disposal, recycling, salvage and items to remain.
- .2 Locate and protect utilities, preserve active utilities traversing site in operating condition.
- .3 Temporary Erosion and Sedimentation Control:
 - .1 Provide a sediment and erosion control plan as per Section 01 35 43 - Environmental Protection
- .4 Prior to beginning removal operation, inspect and verify with DCC Representative areas, depths and lines of asphalt pavement to be removed.
- .5 Protect existing pavement not designated for removal, light units and structures from damage. In event of damage, immediately replace or make repairs to approval of DCC Representative at no additional cost to DCC or the Owner.

3.2 REMOVAL

- .1 Remove existing asphalt pavement to lines and grades as indicated, and as required in order to perform trenching and underground works. Saw cut along limit of asphalt to be removed.
 - .1 Where there is one (1) lift of asphalt, the existing pavement shall be saw cut to provide a proper butt joint.
 - .2 Where there is two (2) or more lifts of asphalt, each upper course of asphalt shall be stepped back 300mm from the lower joint.
- .2 Demolition of pavements, curbs and gutters:
 - .1 Square up adjacent surfaces to remain in place by saw cutting or other method acceptable to DCC Representative.
 - .2 Protect adjacent joints and load transfer devices.
 - .3 Protect underlying and adjacent granular materials where they are exposed and identified to remain.
 - .4 Prevent contamination with base course aggregates, when removing asphalt pavement for subsequent incorporation into hot mix asphalt concrete paving.
 - .5 Step asphalt pavement adjacent to asphalt is to remain and where indicated
- .3 Use equipment and methods of removal and hauling which do not damage or disturb underlying pavement.
- .4 Prevent contamination of removed asphalt pavement by topsoil, underlying gravel or other materials.
- .5 Suppress dust generated by removal process.

3.3 FINISH TOLERANCES

- .1 Finished surfaces in areas where asphalt pavement has been removed to be within +/-10 mm of grade specified but not uniformly high or low.

3.4 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.
 - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.
- .3 Sweep remaining asphalt pavement surfaces clean of debris resulting from removal operations using rotary power brooms and hand brooming as required.

END OF SECTION

Part 1 **General**

1.1 **RELATED REQUIREMENTS**

- .1 Section 03 20 00 – Concrete Reinforcing.
- .2 Section 03 30 00 – Cast-in-Place Concrete.

1.2 **REFERENCES**

- .1 Canadian Standards Association (CSA International)
- .1 CSA-23.1-19/A23.2-19, Concrete Materials and Methods of Concrete Construction/Methods of Test and Standard Practices for Concrete.
- .2 CAN/CSA-O325-16, Construction Sheathing.
- .3 CSA S269.1-16, Falsework for Construction Purposes.
- .4 CSA S269.1-16 (R2021), Falsework and formwork

1.3 **DELIVERY, STORAGE AND HANDLING**

- .1 Waste Management and Disposal:
 - .1 Separate waste materials for reuse and recycling.
 - .2 Place materials defined as hazardous or toxic in designated containers.

Part 2 **Products**

2.1 **MATERIALS**

- .1 Formwork materials:
 - .1 For concrete without special architectural features, use wood and wood product formwork materials to CAN/CSA-O86.
 - .2 Form ties:
 - .1 For concrete not designated 'Architectural', use removable or snap-off metal ties, fixed or adjustable length, free of devices leaving holes larger than 25 mm diameter in concrete surface.
 - .2 For Architectural concrete, use snap ties complete with plastic cones and light grey concrete plugs.
 - .3 Form liner:
 - .1 Plywood: high density overlay.
 - .4 Form release agent: non-toxic, biodegradable, low VOC.
 - .5 Form stripping agent: colourless mineral oil, non-toxic, biodegradable, low VOC, free of kerosene, with viscosity between 15 to 24 mm³ /s at 40°C, flashpoint minimum 150°C, open cup.

- .6 Falsework materials: to CSA-S269.1.

Part 3 **Execution**

3.1 **FABRICATION AND ERECTION**

- .1 Verify lines, levels and centres before proceeding with formwork/falsework and ensure dimensions agree with drawings.
- .2 Obtain DCC Representative's approval for use of earth forms framing openings not indicated on drawings.
- .3 Hand trim sides and bottoms and remove loose earth from earth forms before placing concrete.
- .4 Fabricate and erect falsework in accordance with CSA S269.1.
- .5 Do not place shores and mud sills on frozen ground.
- .6 Provide site drainage to prevent washout of soil supporting mud sills and shores.
- .7 Fabricate and erect formwork in accordance with CSA S269.1-16 (R2021) to produce finished concrete conforming to shape, dimensions, locations and levels indicated within tolerances required by CSA-A23.1/A23.2.
- .8 Align form joints and make watertight.
- .1 Keep form joints to minimum.
- .9 Form chases, slots, openings, drips, recesses, expansion and control joints as indicated.
- .10 Build in anchors, sleeves, and other inserts required to accommodate Work specified in other sections.
- .1 Ensure that anchors and inserts will not protrude beyond surfaces designated to receive applied finishes, including painting.
- .11 Line forms for following surfaces:
 - .1 Secure lining taut to formwork to prevent folds.
 - .2 Pull down lining over edges of formwork panels.
 - .3 Ensure lining is new and not reused material.
 - .4 Ensure lining is dry and free of oil when concrete is poured.
 - .5 Application of form release agents on formwork surface is prohibited where drainage lining is used.
 - .6 If concrete surfaces require cleaning after form removal, use only pressurized water stream so as not to alter concrete's smooth finish.
- .12 Clean formwork in accordance with CSA-A23.1/A23.2, before placing concrete.

3.2 **REMOVAL AND RESHORING**

- .1 Leave formwork in place for following minimum periods of time after placing concrete.
 - .1 3 days for walls and sides of beams.
 - .2 3 days for columns.
 - .3 2 days for footings.
- .2 Remove formwork when concrete has reached 75% of its design strength or minimum period noted above, whichever comes later, and replace immediately with adequate reshoring.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 03 10 00 – Concrete Forming and Accessories.
- .2 Section 03 30 00 – Cast-in-Place Concrete

1.2 REFERENCES

- .1 ASTM International
 - .1 ASTM A1064/A1064M-18a, Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete.
 - .2 ASTM A775/A775M-19, Standard Specification for Epoxy-Coated Steel Reinforcing Bars.
 - .3 ASTM A185/A185M, Standard Specification for Steel Welded Wire Reinforcement, Plain, for Concrete.
- .2 CSA International
 - .1 CSA-23.1-19/A23.2-19, Concrete Materials and Methods of Concrete Construction/ Test Methods and Standard Practices for Concrete.
 - .2 CSA-23.3-19, Design of Concrete Structures.
 - .3 CSA-G30.18:21, Carbon Steel Bars for Concrete Reinforcement.
 - .4 CSA-G40.20/G40.21-14, General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steel.
 - .5 CSA-G164-18 (R2023), Hot Dip Galvanizing of Irregularly Shaped Articles.
- .3 Reinforcing Steel Institute of Canada (RSIC)
 - .1 RSIC-2020, Reinforcing Steel Manual of Standard Practice.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 – Submittal Procedures.
- .2 Prepare reinforcement drawings in accordance with RSIC Manual of Standard Practice.
- .3 Shop Drawings:
 - .1 Submit drawings which:
 - .1 Indicate placing of reinforcement and:
 - .1 Bar bending details.
 - .2 Lists.
 - .3 Quantities of reinforcement.
 - .4 Sizes, spacings, locations of reinforcement with identifying code marks to permit correct placement without reference to structural drawings.
 - .5 Indicate sizes, spacings and locations of chairs, spacers and hangers.
 - .2 Detail lap lengths and bar development lengths to CAN/CSA-A23.3, unless otherwise indicated.
 - .1 Provide type B tension lap splices unless otherwise indicated.

1.4 QUALITY ASSURANCE

- .1 Submit in accordance with Section 01 45 00 – Quality Control and as described in PART 2 - SOURCE QUALITY CONTROL.
 - .1 Mill Test Report: upon request, provide DCC Representative with certified copy of mill test report of reinforcing steel.
 - .2 Upon request submit in writing to DCC Representative proposed source of reinforcement material to be supplied.

1.5 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 – Common Product Requirements.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store materials off ground in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Replace defective or damaged materials with new.

Part 2 Products

2.1 MATERIALS

- .1 Substitute different size bars only if permitted in writing by DCC Representative.
- .2 Reinforcing steel: billet steel, grade 400, deformed bars to CSA-G30.18, unless indicated otherwise.
- .3 Reinforcing steel: weldable low alloy steel deformed bars to CSA-G30.18.
- .4 Cold-drawn annealed steel wire ties: to ASTM A1064.
- .5 Deformed steel wire for concrete reinforcement: to ASTM A1064.
- .6 Welded steel wire fabric: to ASTM A185/A185M.
 - .1 Provide in flat sheets only.
- .9 Chairs, bolsters, bar supports, spacers: to CSA-A23.1/A23.2.

2.2 FABRICATION

- .1 Fabricate reinforcing steel in accordance with CSA-A23.1/A23.2 and Reinforcing Steel Manual of Standard Practice by the Reinforcing Steel Institute of Canada.
- .2 Obtain DCC Representative's written approval for locations of reinforcement splices other than those shown on placing drawings.

- .3 Upon approval of DCC Representative, weld reinforcement in accordance with CSA W186.
- .4 Ship bundles of bar reinforcement, clearly identified in accordance with bar bending details and lists.
 - .1 Ship epoxy coated bars in accordance with ASTM A775A/A775M.

2.3 SOURCE QUALITY CONTROL

- .1 Upon request, provide DCC Representative with certified copy of mill test report of reinforcing steel, showing physical and chemical analysis.
- .2 Upon request inform DCC Representative of proposed source of material to be supplied.

Part 3 Execution

3.1 FIELD BENDING

- .1 Do not field bend or field weld reinforcement except where indicated or authorized by DCC Representative.
- .2 When field bending is authorized, bend without heat, applying slow and steady pressure.
- .3 Replace bars, which develop cracks or splits.

3.2 PLACING REINFORCEMENT

- .1 Place reinforcing steel as indicated on placing drawings and in accordance with CSA-A23.1/A23.2.
- .2 Prior to placing concrete, obtain DCC Representative's approval of reinforcing material and placement.
- .3 Ensure cover to reinforcement is maintained during concrete pour.
- .4 Protect epoxy coated portions of bars with covering during transportation and handling.

3.3 FIELD TOUCH-UP

- .1 Touch up damaged and cut ends of epoxy coated or galvanized reinforcing steel with compatible finish to provide continuous coating.

3.4 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.
 - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 03 10 00 – Concrete Forming and Accessories.
- .2 Section 03 20 00 – Concrete Reinforcing.

1.2 REFERENCES

- .1 Abbreviations and Acronyms:
 - .1 Portland Cement: hydraulic cement, blended hydraulic cement and Portland-limestone cement.
 - .1 Type GU – General use cement.
 - .2 Tupe GUL – General use Portland-limestone cement.
- .2 Reference Standards:
 - .1 ASTM International
 - .1 ASTM C260/C260M-10a(2016), Standard Specification for Air-Entraining Admixtures for Concrete.
 - .2 ASTM C309-19, Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete.
 - .3 C494/C494M-19, Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete.
 - .4 ASTM C1017/C1017M-13e1, Standard Specification for Chemical Admixtures for Use in Producing Flowing Concrete.
 - .5 ASTM D1751-18, Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types).
 - .2 CSA International
 - .1 CSA-23.1-19/A23.2-19, Concrete Materials and Methods of Concrete Construction/Tests Methods and Standard Practices for Concrete.
 - .2 CSA-A283-19, Qualification Code for Concrete Testing Laboratories.
 - .3 CSA-A3000-18, Cementitious Materials Compendium (Consists of A3001, A3002, A3003, A3004 and A3005).

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00 – Submittal Procedures.
- .2 Provide testing inspection results and reports for review by DCC Representative and do not proceed without written approval when deviations from mix design or parameters are found.
- .3 Concrete pours: provide accurate records of poured concrete items indicating date and location of pour, quality, air temperature and test samples taken as described in PART 3 - FIELD QUALITY CONTROL.
- .4 Concrete hauling time: maximum allowable time of 120 minutes for concrete to be delivered to site of Work and discharged after batching.

1.4 QUALITY ASSURANCE

- .1 Quality Assurance: in accordance with Section 01 45 00 - Quality Control.
- .2 Provide DCC Representative, minimum 4 weeks prior to starting concrete work, with valid and recognized certificate from plant delivering concrete.
 - .1 Provide test data and certification by qualified independent inspection and testing laboratory that materials and mix designs used in concrete mixture will meet specified requirements.
- .3 Minimum 4 weeks prior to starting concrete work, provide proposed quality control procedures for review by DCC Representative on following items:
 - .1 Hot weather concrete.
 - .2 Cold weather concrete.
 - .3 Curing.
 - .4 Finishes.
 - .5 Formwork removal.
 - .6 Joints.
- .4 Quality Control Plan: provide written report to DCC Representative verifying compliance that concrete in place meets performance requirements of concrete as established in PART 2 - PRODUCTS.

1.5 DELIVERY, STORAGE AND HANDLING

- .1 Delivery and Acceptance Requirements:
 - .1 Concrete hauling time: deliver to site of Work and discharged within 120 minutes maximum after batching.
 - .1 Do not modify maximum time limit without receipt of prior written agreement from DCC Representative and concrete producer as described in CSA A23.1/A23.2.
 - .2 Deviations to be submitted for review by DCC Representative.
 - .2 Concrete delivery: ensure continuous concrete delivery from plant meets CSA A23.1/A23.2.

Part 2 Products

2.1 DESIGN CRITERIA

- .1 Alternative 1 - Performance: to CSA A23.1/A23.2, and as described in MIXES of PART 2 - PRODUCTS.

2.2 PERFORMANCE CRITERIA

- .1 Quality Control Plan: ensure concrete supplier meets performance criteria of concrete as established by DCC Representative and provide verification of compliance as described in PART 1 - QUALITY ASSURANCE.

2.3 MATERIALS

- .1 Portland Cement: to CSA A3001, Type GU or Type GUL.
- .2 Water: to CSA A23.1.
- .3 Aggregates: to CSA A23.1/A23.2.
- .4 Admixtures:
 - .1 Air entraining admixture: to ASTM C 260.
 - .2 Chemical admixture: to ASTM C494.
- .5 Shrinkage compensating grout: premixed compound consisting of non-metallic aggregate, Portland cement, water reducing and plasticizing agents to CSA A23.1/A23.2.
 - .1 Compressive strength: 40 MPa at 28 days.
- .6 Non premixed dry pack grout: composition of non-metallic aggregate Portland cement with sufficient water for mixture to retain its shape when made into ball by hand and capable of developing compressive strength of 40 MPa at 28 days.
- .7 Premoulded joint fillers:
 - .1 Bituminous impregnated fiber board: to ASTM D 1751.

2.4 MIXES

- .1 Alternative 1 - Performance Method for specifying concrete: to meet DCC Representative performance criteria to CSA A23.1/A23.2.
 - .1 Ensure concrete supplier meets performance criteria as established below and provide verification of compliance as in Quality Control Plan.
 - .2 Provide concrete mix to meet following hard state requirements:
 - .1 Durability and class of exposure: C-1.
 - .2 Compressive strength at 28 days: 25 Mpa minimum.
 - .3 Intended application: Footings, Piers, Foundation walls, suspended slabs, Exterior Slabs, taxiway PCC slab, bollards.
 - .4 Aggregate size 20 mm maximum.

Part 3 Execution

3.1 PREPARATION

- .1 Obtain DCC Representative's written approval before placing concrete.
 - .1 Provide 24 hours minimum notice prior to placing of concrete.
- .2 Place concrete reinforcing in accordance with Section 03 20 00 - Concrete Reinforcing.
- .3 During concreting operations:
 - .1 Development of cold joints not allowed.

- .2 Ensure concrete delivery and handling facilitates placing with minimum of re-handling, and without damage to existing structure or Work.
- .4 Pumping of concrete is permitted only if in accordance with 8-Wing crane policy.
- .5 Ensure reinforcement and inserts are not disturbed during concrete placement.
- .6 Prior to placing of concrete obtain DCC Representative's approval of proposed method for protection of concrete during placing and curing in adverse weather.
- .7 Protect previous Work from staining.
- .8 Clean and remove stains prior to application for concrete finishes.
- .9 Maintain accurate records of poured concrete items to indicate date, location of pour, quality, air temperature and test samples taken.
- .10 In locations where new concrete is dowelled to existing work, drill holes in existing concrete.
 - .1 Place steel dowels of deformed steel reinforcing bars and pack solidly with epoxy grout to anchor and hold dowels in positions as indicated.
- .11 Do not place load upon new concrete until authorized by DCC Representative.

3.2 **INSTALLATION/ APPLICATION**

- .1 Do cast-in-place concrete work to CSA A23.1/A23.2.
- .2 Sleeves and inserts:
 - .1 Where approved by DCC Representative, set sleeves, ties, pipe hangers and other inserts and openings as indicated or specified elsewhere.
 - .2 Sleeves and openings greater than 100 x 100 mm not indicated, must be reviewed by DCC Representative.
 - .3 Do not eliminate or displace reinforcement to accommodate hardware. If inserts cannot be located as specified, obtain written approval of modifications from DCC Representative before placing of concrete.
 - .4 Confirm locations and sizes of sleeves and openings shown on drawings.
 - .5 Set special inserts for strength testing as indicated and as required by non-destructive method of testing concrete.
- .3 Anchor bolts:
 - .1 Set anchor bolts to templates in co-ordination with appropriate trade prior to placing concrete.
- .4 Grout under base plates using procedures in accordance with manufacturer's recommendations which result in 100% contact over grouted area.
- .5 Finishing and curing:
 - .1 Finish concrete to CSA A23.1/A23.2.
 - .2 Use procedures as reviewed by DCC Representative to remove excess bleed water. Ensure surface is not damaged.
 - .3 Use curing compounds compatible with applied finish on concrete surfaces.

- .4 Finish concrete floor to CSA A23.1/A23.2.
- .5 Rub exposed sharp edges of concrete with carborundum to produce 3 mm minimum radius edges unless otherwise indicated.
- .6 Joint fillers:
 - .1 Furnish filler for each joint in single piece for depth and width required for joint, unless otherwise authorized by DCC Representative.
 - .2 When more than one piece is required for joint, fasten abutting ends and hold securely to shape by stapling or other positive fastening.
 - .3 Locate and form construction joints as indicated.
 - .4 Install joint filler.
 - .5 Use 10 mm thick joint filler to separate slabs-on-grade from vertical surfaces and extend joint filler from bottom of slab to finished slab surface unless indicated otherwise.

3.3 FIELD QUALITY CONTROL

- .1 Site tests: conduct tests as follows in accordance with Section 01 45 00 - Quality Control and submit report as described in PART 1 - ACTION AND INFORMATIONAL SUBMITTALS.
 - .1 Concrete pours.
 - .2 Slump.
 - .3 Air content.
 - .4 Compressive strength at 7 and 28 days.
 - .5 Air and concrete temperature.
- .2 Inspection and testing of concrete and concrete materials will be carried out by testing laboratory designated by DCC Representative for review to CSA A23.1/A23.2.
- .3 Contractor will pay for costs of tests.
- .4 DCC Representative will take additional test cylinders during cold weather concreting. Cure cylinders on job site under same conditions as concrete which they represent.
- .5 Non-Destructive Methods for Testing Concrete: to CSA A23.1/A23.2.
- .6 Inspection or testing by Consultant will not augment or replace Contractor quality control nor relieve Contractor of his contractual responsibility.

3.4 CLEANING

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

END OF SECTION

Part 1 General

1.1 REFERENCE STANDARDS

- .1 ASTM International (ASTM)
 - .1 ASTM C309-19, Liquid Membrane-Forming Compounds for Curing Concrete
- .2 Canadian General Standards Board (CGSB)
 - .1 CAN/CGSB-25.20-95, Surface Sealer for Floors
- .3 CSA Group (CSA)
 - .1 CSA-23.1-19/A23.2-19, Concrete Materials and Methods of Concrete Construction/ Test Methods and Standard Practices for Concrete

1.2 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Provide manufacturer's printed product literature and data sheets for concrete finishes and include product characteristics, performance criteria, physical size, finish and limitations.
 - .2 Submit WHMIS Safety Data Sheet (SDS) in accordance with Section 01 33 00
 - .3 Include application instructions for concrete floor treatment.

1.3 QUALITY ASSURANCE

- .1 Quality Assurance: in accordance with Section 01 45 00 - Quality Control.

1.4 DELIVERY, STORAGE AND HANDLING

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

1.5 SITE CONDITIONS

- .1 Temporary lighting: Representative of final lighting conditions
- .2 Electrical power: Provide sufficient electrical power to operate equipment normally used during construction.
- .3 Work area: Make work area water tight protected against rain and detrimental weather conditions.
- .4 Temperature: Maintain minimum 10 degrees C ambient temperature for 7 days before installation and minimum 48 hours after completion of work and maintain relative humidity maximum 40 % during same period.
- .5 Moisture: Ensure concrete substrate is within moisture limits prescribed by floor sealer manufacturer.
- .6 Safety: Comply with requirements of Workplace Hazardous Materials Information System (WHMIS) regarding use, handling, storage, and disposal of hazardous materials.

- .7 Ventilation:
 - .1 DCC Representative will arrange for ventilation system to be operated during installation of concrete floor treatment materials.
 - .2 Provide continuous ventilation during and after coating application.

Part 2 Products

2.1 PERFORMANCE REQUIREMENTS

- .1 Product quality and quality of work in accordance with Section 01 61 00 - Common Product Requirements.
- .2 Submit written declaration components used compatible and not adversely affect finished flooring products and their installation adhesives.

2.2 CHEMICAL HARDENERS

- .1 Type 1 - Sodium silicate.
- .2 Water: potable.

2.3 SEALING COMPOUNDS

- .1 Surface sealer: acrylic carnuba wax, colour clear
- .2 Surface sealers not contain aromatic solvents, formaldehyde, halogenated solvents, mercury, lead, cadmium, hexavalent chromium and their compounds.
- .3 VOC limit: maximum 100g/L

2.4 CURING COMPOUNDS

- .1 Waterborne membrane forming curing membrane to ASTM C309, Type 1 Clear.
 - .1 Verify compatibility with subsequent finishes.

2.5 MIXES

- .1 Mixing ratios in accordance with manufacturer's written instructions.

Part 3 Execution

3.1 EXAMINATION

- .1 Verify slab surfaces are ready to receive work as recommended by manufacturer's written instructions.

3.2 APPLICATION

- .1 Apply concrete finishing floor hardener in accordance with manufacturer's written instructions.
- .2 After floor treatment dry, seal control joints and joints at junction with vertical surfaces with sealant.
- .3 Apply floor treatment in accordance with Sealer manufacturer's written instructions.
- .4 Clean over spray. Clean sealant from adjacent surfaces.

3.3 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.
 - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.

3.4 PROTECTION

- .1 Protect finished installation in accordance with manufacturer's instructions.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 07 92 00 - Joint Sealants

1.2 REFERENCE STANDARDS

- .1 ASTM International (ASTM):
 - .1 ASTM C 1177/C 1177M-08, Standard Specification for Glass Mat Gypsum Substrate for Use as Sheathing
 - .2 ASTM D 41/D 41M-11, Standard Specification for Asphalt Primer Used in Roofing, Dampproofing, and Waterproofing
 - .3 ASTM D 449-03(2008), Standard Specification for Asphalt Used in Dampproofing and Waterproofing
 - .4 ASTM D 2178-04, Standard Specification for Asphalt Glass Felt Used in Roofing and Waterproofing
- .2 Canadian General Standards Board (CGSB):
 - .1 CGSB 37-GP-9Ma-83, Primer, Asphalt, Unfilled, for Asphalt Roofing, Dampproofing
 - .2 CAN/CGSB-37.29-M89, Rubber-Asphalt Sealing Compound
 - .3 CAN/CGSB-37.50-M89, Hot Applied, Rubberized Asphalt for Roofing and Waterproofing
 - .4 CAN/CGSB-37.51-M90, Application for Hot-Applied Rubberized Asphalt, for Roofing and Waterproofing
 - .5 CAN/CGSB-51.34-M86(R1988), Vapour Barrier, Polyethylene Sheet for Use in Building Construction
- .3 CSA Group (CSA):
 - .1 CSA A231.1/A231.2-06(R2010), Precast Concrete Paving Slabs/ Precast Concrete Pavers
 - .2 CSA O121-2008, Douglas Fir Plywood
 - .3 CSA O151-09, Canadian Softwood Plywood
- .4 Department of Justice Canada (Jus):
 - .1 Canadian Environmental Protection Act (CEPA), 1999 (R2008)
 - .2 Transportation of Dangerous Goods Act (TDGA), 1992
- .5 National Research Council Canada (NRC) - Canadian Construction Materials Centre (CCMC):
 - .1 CCMC Registry of Product Evaluations
- .6 Underwriters' Laboratories of Canada (ULC):
 - .1 CAN/ULC-S701-11, Standard for Thermal Insulation, Polystyrene, Boards and Pipe Covering
 - .2 CAN/ULC-S704-2011, Standard for Thermal Insulation, Polyurethane and Polyisocyanurate Boards, Faced

- .3 CAN/ULC-S706-09, Standard for Wood Fibre Thermal Insulation for Buildings

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for applied rubberized asphalt waterproofing and include product characteristics, performance criteria, physical size, finish and limitations.
 - .2 Submit 2 copies of WHMIS SDS in accordance with Section 01 35 43 - Environmental Procedures.
- .3 Shop Drawings:
 - .1 Indicate on drawings:
 - .1 Control joints.
 - .2 Penetrations.
 - .3 Site fabricated seams.

1.4 QUALITY ASSURANCE

1.5 DELIVERY, STORAGE, AND HANDLING

- .1 Deliver, store and handle materials in accordance with manufacturer's written instructions.
- .2 Stand roll materials on end.
- .3 Remove only in quantities required for same day use.
- .4 Store insulation protected from sunlight and weather and deleterious materials.

1.6 SITE CONDITIONS

- .1 Ambient Conditions.
- .2 Temperature, relative humidity, moisture content.
 - .1 Apply membranes only when surfaces and ambient temperatures are within manufacturers' prescribed limits.
 - .2 Do not install membrane when air and substrate temperature remains below 5 degrees C, or when wind chill gives equivalent cooling effect.
 - .3 Install membrane on dry substrate, free of snow and ice, use only dry materials and apply only during weather that will not introduce moisture into system.

1.7 WARRANTY

- .1 For the Work of this Section 07 14 13 - Hot Fluid-Applied Rubberized Asphalt Waterproofing the 12 months warranty period is extended to 24 months.

Part 2 Products

2.1 PERFORMANCE REQUIREMENTS

- .1 Waterproofing System: capable of resisting moisture/water head of 2500 mm, and preventing moisture migration to interior.

2.2 COMPATIBILITY

- .1 Compatibility between components of system and adjacent materials is essential. Provide written declaration to DCC Representative stating that materials and components, as assembled in system, meet this requirement.

2.3 PRIMERS

- .1 Asphalt primer: to CGSB 37-GP-9Ma.

2.4 RUBBERIZED ASPHALT

- .1 Hot applied rubberized asphalt: to CAN/CGSB-37.50, VOC content 36g/L.

2.5 REINFORCEMENT

- .1 Membrane reinforcement: fabric, glass mat or spun-bonded polyester as recommended by membrane manufacturer.
- .2 Crack and joint reinforcement: elastomeric sheet, Butyl, EPDM or Chloroprene rubber, uncured neoprene thickness minimum 1.6 mm.

2.6 SEPARATION SHEET

- .1 Asphalt impregnated glass felt: to ASTM D 2178, Type IV.
- .2 Polyethylene film: to CAN/CGSB-51.34, Type 1, 0.125 mm thick.

2.7 POLYSTYRENE INSULATION

- .1 Extruded polystyrene (XPS) insulation to CAN/ULC-S701, Type 4, thickness mm as indicated, shiplapped edges.

2.8 JOINT TAPE

- .1 Tape: pressure sensitive heat resistant fibreglass reinforced type.

2.9 LATEX FILLER

- .1 Filler: latex modified cement.

2.10 SOURCE QUALITY CONTROL

- .1 Submit laboratory test reports in accordance with Section 01 45 00 - Quality Control.

Part 3 Execution

3.1 EXAMINATION

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate in presence of DCC Representative.
 - .2 Inform DCC Representative of unacceptable conditions immediately upon discovery.
 - .3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from DCC Representative.
- .2 Before start of Work make sure:
 - .1 Substrates are firm, straight, smooth, dry, free of snow, ice or frost, contamination and swept clean of dust and debris.
 - .2 Curbs have been built.
 - .3 Drains have been installed at proper elevations relative to finished surfaces.
 - .4 Sleeves, vents, pipes and other items passing through substrates receiving work of this Section are properly and rigidly installed.

3.2 PREPARATION

- .1 Cover walls, walks and adjacent work where materials hoisted or used.
- .2 Use warning signs and barriers. Maintain in good order until completion of Work.
- .3 Clean off drips and smears of bituminous material immediately.
- .4 Dispose of rain water away from face of building until drains or hoppers installed and connected.
- .5 Protect from traffic and damage. Comply with precautions deemed necessary by DCC Representative.
- .6 Place plywood runways over work to enable movement of material and other traffic.
- .7 At end of each day's work or when stoppage occurs due to inclement weather, provide protection for completed Work and materials out of storage.
- .8 Seal exposed edges.
- .9 Free substrates from curing compounds, dust and loose particles, grease, paint, frost, form oil and other material detrimental to bond of membrane materials.
- .10 Heat membrane in double shell indirect fired melter using high flash point oil as heat transfer medium. Equip melter with positive mechanically operated agitator, and thermometers. Under no circumstances is membrane material to be heated in direct heating kettle.
- .11 Reinforce substrate cracks less than 3 mm wide with layer of hot rubberized asphalt 300 mm wide centred on crack and 150 mm wide fabric reinforcing sheet embedded into it.

- .12 Reinforce substrate cracks larger than 3 mm with layer of hot rubberized asphalt 300 mm wide centred over crack and 225 mm wide strip of standard thickness elastomeric reinforcing sheet embedded into it.
- .13 At expansion joints, loop heavy duty elastomeric reinforcing sheet down into joint, embedded into 3 mm thick layer to membrane. Ensure that depth of loop is minimum 1.5 mm. Extend reinforcing sheet minimum 150 mm on each side of joint. Cap end joints minimum of 150 mm and seal with 3 mm coat of membrane. Fill loop with membrane. Secure top of reinforcing sheet with continuous fixing bar at vertical wall locations.
- .14 At mechanical vent and pipe flashings, provide standard elastomeric reinforcing sheet around vent pipes and protrusions through membrane. Set and seal with membrane and clamping ring. Install prefabricated metal sleeves for substrate perforations.
- .15 At drain flashings, extend membrane and standard elastomeric reinforcing into upper surface of drain base and ensure watertight seal between membrane and drain. Apply clamping ring exerting sufficient pressure to affect seal between clamping ring and membrane. Temporarily block drains during application of ballast, or other materials which might block drains. Remove blocking when work is not in progress and upon completion.

3.3 PREPARATION OF CONCRETE

- .1 Fill surface honeycomb depressions and voids with latex filler.
- .2 Apply primer to dry substrate in accordance with CAN/CGSB-37.51.

3.4 MEMBRANE

- .1 Install hot applied rubberized asphalt, reinforcement fabric and flashings in accordance with CAN/CGSB-37.51.
- .2 Ensure continuity of building envelope air barrier.

3.5 SEPARATION SHEET

- .1 Place separation sheet in asphalt while still hot enough to assure good bond but not so hot as to damage sheet.
- .2 Begin application at low end, lapping sheets 50 mm.
- .3 Carry sheet up vertical faces over rubberized asphalt while still warm.

3.6 OVERLAY BOARD

- .1 Install protection board while rubberized asphalt membrane is still "tacky". Lap 10 to 25 mm to ensure complete coverage.

3.7 SITE QUALITY CONTROL

- .1 Inspection and testing of membrane application will be carried out by testing laboratory designated by DCC Representative.

3.8 PROTECTION

- .1 Ensure membrane is undamaged before application of protection board.
- .2 Apply protection board to cover membrane below grade.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

- .1 Section 01 33 00 – Submittal Procedures
- .2 Section 09 91 23 – Interior Painting

1.2 REFERENCES

- .1 American Society for Testing and Materials International, (ASTM)
 - .1 ASTM C834-17, Standard Specification for Latex Sealants.
 - .2 ASTM C920-18, Standard Specification for Elastomeric Joint Sealants.
- .2 Canadian General Standards Board (CGSB)
 - .1 CAN/CGSB-19.21-M87, Sealing and Bedding Compound, Acoustical

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit product data in accordance with Section 01 33 00.
- .2 Product Data: Submit manufacturer's installation instructions, printed product literature and data sheets for sealants, caulking, primers and include product characteristics, performance criteria, colour charts and limitations.

1.4 QUALITY ASSURANCE

- .1 Test Reports: submit certified test reports showing compliance with specified performance characteristics and physical properties.

1.5 DELIVERY, STORAGE, AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 and with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store materials off ground, in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Replace defective or damaged materials with new.

1.6 PROJECT CONDITIONS

- .1 Environmental Limitations:
 - .1 Do not proceed with installation of joint sealants under following conditions:
 - .1 When ambient and substrate temperature conditions are outside limits permitted by joint sealant manufacturer or are below 5°C.
 - .2 When joint substrates are wet.

- .3 Conform to manufacturer's recommended temperatures, relative humidity, and substrate moisture content for application and curing of sealants including special conditions governing use.
- .2 Joint-Width Conditions:
 - .1 Do not proceed with installation of joint sealants where joint widths are less than those allowed by joint sealant manufacturer for applications indicated.
- .3 Joint-Substrate Conditions:
 - .1 Do not proceed with installation of joint sealants until contaminants capable of interfering with adhesion are removed from joint substrates.

Part 2 Products

2.1 SEALANT MATERIALS

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

2.2 SEALANT MATERIAL DESIGNATIONS

- .1 Silicone Sealant:
 - .1 High-performance, single-component, moisture-cure, ultralow modulus silicone sealant.
 - .2 To ASTM C920 Type S, Grade NS, Class 100/50, Use NT, M, G, A and O.
- .2 Latex Sealant:
 - .1 Pure acrylic latex sealant formulated to provide a fast-setting pliable seal with minimal shrinkage.
 - .2 To ASTM C834, Type OP, Grade -18 °C
- .3 Acoustical Sealant.
 - .1 Single component, non-skinning, non-hardening synthetic rubber sealant.
 - .2 To CAN/CGSB 19.21 M87.
- .4 Preformed Compressible and Non-Compressible back-up materials.
 - .1 Polyethylene, Urethane, Neoprene or Vinyl Foam.
 - .1 Extruded open or closed cell foam backer rod.
 - .2 Size: oversize 30 to 50%.
 - .2 Bond Breaker Tape.
 - .1 Polyethylene bond breaker tape which will not bond to sealant.
- .5 Acoustical / Firestop Sealant at dielectric breaks.
 - .1 Single component, non-skinning, non-hardening water based sealant.
 - .2 To CAN/CGSB 19.21 M87.
 - .3 4 hour fire resistance rating

- .4 Sound transmission class of minimum 51.

2.3 SEALANT SELECTION

- .1 Unless otherwise noted use:
 - .1 Silicone Sealant for all exterior applications.
 - .2 Latex Sealant for all interior applications.

2.4 JOINT CLEANER

- .1 Non-corrosive and non-staining type, compatible with joint forming materials and sealant recommended by sealant manufacturer.
- .2 Primer: as recommended by manufacturer.

Part 3 Execution

3.1 PROTECTION

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

3.2 SURFACE PREPARATION

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

3.3 PRIMING

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

3.4 BACKUP MATERIAL

- .1 Apply bond breaker tape where required to manufacturer's instructions.
- .2 Install joint filler to achieve correct joint depth and shape, with approximately 30% compression.

3.5 APPLICATION

- .1 Sealant.
 - .1 Apply sealant in accordance with manufacturer's written instructions.
 - .2 Mask edges of joint where irregular surface or sensitive joint border exist to provide neat joint.

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

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

- .1 Section 01 33 00 - Submittal Procedures.
- .2 Section 07 92 00 - Sealants.

1.2 REFERENCE STANDARDS

- .1 Environmental Protection Agency (EPA)
 - .1 Test Method for Measuring Total Volatile Organic Compound Content of Consumer Products, EPA Method 24 - Surface Coatings.
 - .2 SW-846, Test Methods for Evaluating Solid Waste: Physical/Chemical Methods.
- .2 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
 - .1 Material Safety Data Sheets (MSDS).
- .3 Master Painters Institute (MPI)
 - .1 The Master Painters Institute (MPI)/Architectural Painting Specification Manual (ASM) - current edition.
 - .2 Standard GPS-1, MPI Green Performance Standard.
 - .3 Standard GPS-2, MPI Green Performance Standard.
- .4 National Research Council Canada (NRC)
 - .1 National Fire Code of Canada (NFC).

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide in accordance with Section 01 33 00 – Submittal Procedures.
- .2 Product Data:
 - .1 Provide manufacturer's instructions, printed product literature and data sheets for paint and paint products and include product characteristics, performance criteria, physical size, finish and limitations.
 - .2 Submit WHMIS MSDS for paint products specified.
 - .3 Confirm products to be used are in MPI's approved product list.
- .3 Upon completion, provide records of products used. List products in relation to finish system and include the following:
 - .1 Product name, type and use.
 - .2 Manufacturer's product number.
 - .3 Colour numbers.
 - .4 MPI Environmentally Friendly classification system rating.
 - .5 Manufacturer's Material Safety Data Sheets (MSDS).
- .4 Samples:
 - .1 Submit full range colour sample chips to indicate where colour availability is restricted.

- .2 duplicate 200 x 300 mm sample panels of each paint with specified paint or coating in colours, gloss/sheen and textures required to MPI Architectural Painting Specification Manual standards submitted on following substrate materials:
 - .1 50 mm concrete block for finishes over concrete or concrete masonry surfaces.
 - .2 gypsum board 13 mm for finishes over gypsum board and other smooth surfaces.
- .3 Retain reviewed samples on-site to demonstrate acceptable standard of quality for appropriate on-site surface.
- .5 Manufacturer's Instructions:
 - .1 Provide manufacturer's installation instructions.

1.4 CLOSEOUT SUBMITTALS

- .1 Provide in accordance with Section 01 78 00 – Closeout Submittals.
- .2 Operation and Maintenance Data: Provide operation and maintenance data for incorporation into manual.
- .3 Include:
 - .1 Product name, type and use.
 - .2 Manufacturer's product number.
 - .3 Colour number(s).
 - .4 MPI Environmentally Friendly classification system rating.

1.5 MAINTENANCE MATERIAL SUBMITTALS

- .1 Extra Stock Materials:
 - .1 Submit 1, four litre can of each type and colour of finish coating. Identify colour and paint type in relation to established colour schedule and finish system.

1.6 QUALITY ASSURANCE

- .1 Qualifications:
 - .1 Qualified journeypersons as defined by local jurisdiction to be engaged in painting work.
 - .2 Apprentices: may be employed provided they work under direct supervision of qualified journeyperson in accordance with trade regulations.
 - .3 Materials: in accordance with MPI Painting Specification Manual "Approved Product" listing and from a single manufacturer for each system used.
 - .4 Standard of Acceptance:
 - .1 Walls: no defects visible from a distance of 1000 mm at 90 degrees to surface.
 - .2 Final coat to exhibit uniformity of colour and uniformity of sheen across full surface area.

1.7 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
 - .1 Labels: to indicate:

- .1 Type of paint or coating.
- .2 Compliance with applicable standard.
- .3 Colour number in accordance with established colour schedule.
- .3 Storage and Handling Requirements:
 - .1 Store materials in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Observe manufacturer's recommendations for storage and handling.
 - .3 Store materials and supplies away from heat generating devices.
 - .4 Store materials and equipment in well ventilated area with temperature range 7 degrees C to 30 degrees C.
 - .5 Remove paint materials from storage only in quantities required for same day use.
 - .6 Comply with requirements of Workplace Hazardous Materials Information System (WHMIS) regarding use, handling storage, and disposal of hazardous materials.

1.8 SITE CONDITIONS

- .1 Ambient Conditions:
 - .1 Heating, Ventilation and Lighting:
 - .1 Ventilate enclosed spaces in accordance with OH&S and department specific policies.
 - .2 Provide heating facilities to maintain ambient air and substrate temperatures above 10 degrees C for 24 hours before, during and after paint application until paint has cured sufficiently.
 - .3 Provide continuous ventilation for 7 days after completion of application of paint.
 - .4 Co-ordinate use of existing ventilation system with DCC Representative and ensure its operation during and after application of paint as required.
 - .5 Provide temporary ventilating and heating equipment where permanent facilities are not available or supplemental ventilating and heating equipment if ventilation and heating from existing system is inadequate to meet minimum requirements.
 - .6 Provide minimum lighting level of 323 Lux on surfaces to be painted.
 - .7 Temperature, Humidity and Substrate Moisture Content Levels:
 - .1 Unless pre-approved written approval by product manufacturer, perform no painting when:
 - .1 Ambient air and substrate temperatures are below 10 degrees C.
 - .2 Substrate temperature is above 32 degrees C unless paint is specifically formulated for application at high temperatures.
 - .3 Substrate and ambient air temperatures are not expected to fall within MPI or paint manufacturer's prescribed limits.
 - .4 The relative humidity is under 85% or when the dew point is more than 3 degrees C variance between the air/surface temperature. Paint should not be applied if the dew point is less than 3 degrees C below the ambient or surface temperature. Use sling psychrometer to establish the relative humidity before beginning paint work.

- .5 Rain or snow are forecast to occur before paint has thoroughly cured or when it is foggy, misty, raining or snowing at site.
- .6 Ensure that conditions are within specified limits during drying or curing process, until newly applied coating can itself withstand 'normal' adverse environmental factors.
- .8 Surface and Environmental Conditions:
 - .1 Apply paint finish in areas where dust is no longer being generated by related construction operations or when wind or ventilation conditions are such that airborne particles will not affect quality of finished surface.
 - .2 Apply paint to adequately prepared surfaces and to surfaces within moisture limits.
 - .3 Apply paint when previous coat of paint is dry or adequately cured.
- .9 Additional interior application requirements:
 - .1 Apply paint finishes when temperature at location of installation can be satisfactorily maintained within manufacturer's recommendations.

Part 2 Products

2.1 PERFORMANCE REQUIREMENTS

- .1 Environmental Performance Requirements:
 - .1 Provide paint products meeting MPI "Environmentally Friendly" ratings based on VOC (EPA Method 24) content levels.
 - .2 Green Performance in accordance with MPI Standard GPS-1.

2.2 MATERIALS

- .1 Only Paint materials listed in the MPI Approved Products List (APL) are acceptable for use on this project.
- .2 Provide paint materials for paint systems from single manufacturer.
- .3 Only qualified products with E2 or E3 "Environmentally Friendly" rating are acceptable for use on this project.
- .4 Conform to latest MPI requirements for interior painting work including preparation and priming.
- .5 Provide paint products meeting MPI "Environmentally Friendly" E3 or E2 ratings based on VOC (EPA Method 24) content levels.
- .6 Use MPI listed materials having minimum E3 rating where indoor air quality (odour) requirements exist.
- .7 Paints, coatings, adhesives, solvents, cleaners, lubricants, and other fluids to be:
 - .1 Water clean-up
 - .2 Biodegradable
 - .3 Be manufactured without compounds which contribute to ozone depletion in the upper atmosphere.
 - .4 Be manufactured without compounds which contribute to smog in the lower atmosphere.
 - .5 Do not contain methylene chloride, chlorinated hydrocarbons, toxic metal pigments.

- .8 Ensure manufacture and process of both water-borne surface coatings and recycled water-borne surface coatings does not release:
 - .1 Matter in undiluted production plant effluent generating 'Biochemical Oxygen Demand' (BOD) in excess of 15 mg/L to natural watercourse or sewage treatment facility lacking secondary treatment.
 - .2 Total Suspended Solids (TSS) in undiluted production plant effluent in excess of 15 mg/L to natural watercourse or a sewage treatment facility lacking secondary treatment.
- .9 Water-borne paints and stains, recycled water-borne surface coatings and water borne varnishes to meet minimum "Environmentally Friendly" E2 rating.

2.3 COLOURS

- .1 Colours to be selected by DCC Representative.
- .2 Colour selection will be based upon selection of 5 base colours and 3 accent colours. No more than 8 colours will be selected for entire project and no more than 3 colours will be selected in each area.
- .3 Selection of colours will be from manufacturers full range of colours.
- .4 Where specific products are available in restricted range of colours, selection based on limited range.
- .5 Second coat in three coat system to be tinted slightly lighter colour than top coat to show visible difference between coats.
- .6 For deep and ultra deep colours; 4 coats may be required.

2.4 MIXING AND TINTING

- .1 Perform colour tinting operations prior to delivery of paint to site. Obtain written approval from manufacturer for tinting of painting materials.
- .2 Mix paste, powder or catalyzed paint mixes in accordance with manufacturer's written instructions.
- .3 Use and add thinner in accordance with paint manufacturer's recommendations. Do not use kerosene or similar organic solvents to thin water-based paints.
- .4 Thin paint for spraying in accordance with paint manufacturer's instructions.
- .5 Re-mix paint in containers prior to and during application to ensure break-up of lumps, complete dispersion of settled pigment, and colour and gloss uniformity. Strain as necessary.

2.5 GLOSS/SHEEN RATINGS

- .1 Paint gloss is defined as sheen rating of applied paint, in accordance with following values:

Gloss @ 60 degrees	Sheen @ 85 degrees	
Gloss Level 1 - Matte Finish (flat)	Max. 5	Max. 10
Gloss Level 2 - Velvet-Like Finish	Max.10	10 to 35
Gloss Level 3 - Eggshell Finish	10 to 25	10 to 35
Gloss Level 4 - Satin-Like Finish	20 to 35	min. 35
Gloss Level 5 - Traditional Semi-Gloss Finish	35 to 70	
Gloss Level 6 - Traditional Gloss	70 to 85	

Gloss Level 7 - High Gloss Finish	More than 85	

- .2 Gloss level ratings of painted surfaces as indicated in Paragraph 2.6 below.

2.6 INTERIOR PAINTING SYSTEMS

- .1 Concrete horizontal surfaces: floors and stairs:
- .1 INT 3.2C - Epoxy finish semi-gloss.
- .2 Structural steel and metal fabrications: columns, beams, joists:
- .1 INT 5.1P - High build epoxy (over epoxy zinc rich primer and high build epoxy).
- .3 Galvanized metal: doors, frames, railings, misc. steel, pipes, overhead decking, conduit and ducts.
- .1 INT 5.3A – Latex, Semi-Gloss (over recommended primer) finish.

2.7 SOURCE QUALITY CONTROL

- .1 Perform following tests on each batch of consolidated post-consumer material before surface coating is reformulated and canned. Testing by laboratory or facility which has been accredited by Standards Council of Canada.
- .1 Lead, cadmium and chromium are to be determined using ICP-AES (Inductively Coupled Plasma - Atomic Emission Spectroscopy) technique no. 6010 as defined in EPA SW-846.
- .2 Mercury is to be determined by Cold Vapour Atomic Absorption Spectroscopy using Technique no. 7471 as defined in EPA SW-846.
- .3 Organochlorines and PCBs are to be determined by Gas Chromatography using Technique no. 8081 as defined in EPA SW-846.

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 data sheet.

3.2 GENERAL

- .1 Perform preparation and operations for interior painting in accordance with MPI Architectural Painting Specifications Manual except where specified otherwise.
- .2 Apply paint materials in accordance with paint manufacturer's written application instructions.

3.3 EXAMINATION

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable to be painted in accordance with manufacturer's written instructions.
- .1 Visually inspect substrate and inform DCC Representative of unacceptable conditions immediately upon discovery.
- .2 Proceed with installation only after unacceptable conditions have been remedied.
- .3 Installation constitutes acceptance of job conditions.

3.4 PREPARATION

- .1 Protection:
 - .1 Protect existing building surfaces and adjacent structures from paint spatters, markings and other damage by suitable non-staining covers or masking. If damaged, clean and restore surfaces as directed by DCC Representative.
 - .2 Protect items that are permanently attached such as Fire Labels on doors and frames.
 - .3 Protect factory finished products and equipment.
- .2 Clean and prepare surfaces in accordance with MPI Architectural Painting Specification Manual requirements. Refer to MPI Manual in regard to specific requirements and as follows:
 - .1 Remove dust, dirt, and other surface debris by wiping with dry, clean cloths.
 - .2 Wash surfaces with a biodegradable detergent and bleach where applicable and clean warm water using a stiff bristle brush to remove dirt, oil and other surface contaminants.
 - .3 Rinse scrubbed surfaces with clean water until foreign matter is flushed from surface.
 - .4 Allow surfaces to drain completely and allow to dry thoroughly.
 - .5 Prepare surfaces for water-based painting, water-based cleaners should be used in place of organic solvents.
 - .6 Use trigger operated spray nozzles for water hoses.
 - .7 Many water-based paints cannot be removed with water once dried. Minimize use of mineral spirits or organic solvents to clean up water-based paints.
- .3 Prevent contamination of cleaned surfaces by salts, acids, alkalis, other corrosive chemicals, grease, oil and solvents before prime coat is applied and between applications of remaining coats. Apply primer, paint, or pretreatment as soon as possible after cleaning and before deterioration occurs.
- .4 Sand and dust between coats as required to provide adequate adhesion for next coat and to remove defects visible from a distance up to 1000 mm.
- .5 Touch up of shop primers with primer as specified.

3.5 APPLICATION

- .1 Method of application to be as approved by paint manufacturer and DCC Representative. Apply paint by brush, air sprayer, or roller. Conform to manufacturer's application instructions unless specified otherwise.
- .2 Brush and Roller Application:
 - .1 Apply paint in uniform layer using brush and/or roller type suitable for application.
 - .2 Work paint into cracks, crevices and corners.
 - .3 Paint surfaces and corners not accessible to brush using spray, daubers and/or sheepskins. Paint surfaces and corners not accessible to roller using brush, daubers or sheepskins.
 - .4 Brush and/or roll out runs and sags, and over-lap marks. Rolled surfaces free of roller tracking and heavy stipple.
 - .5 Remove runs, sags and brush marks from finished work and repaint.
- .3 Spray application:
 - .1 Provide and maintain equipment that is suitable for intended purpose, capable of atomizing paint to be applied, and equipped with suitable pressure regulators and gauges.

- .2 Keep paint ingredients properly mixed in containers during paint application either by continuous mechanical agitation or by intermittent agitation as frequently as necessary.
- .3 Apply paint in uniform layer, with overlapping at edges of spray pattern. Back roll first coat application.
- .4 Brush out immediately all runs and sags.
- .5 Use brushes and rollers to work paint into cracks, crevices and places which are not adequately painted by spray.
- .4 Use dipping, sheepskins or daubers only when no other method is practical in places of difficult access.
- .5 Apply coats of paint continuous film of uniform thickness. Repaint thin spots or bare areas before next coat of paint is applied.
- .6 Allow surfaces to dry and properly cure after cleaning and between subsequent coats for minimum time period as recommended by manufacturer.
- .7 Sand and dust between coats to remove visible defects.
- .8 Finish surfaces both above and below sight lines as specified for surrounding surfaces, including such surfaces as tops of interior cupboards and cabinets and projecting ledges.
- .9 Finish closets and alcoves as specified for adjoining rooms.
- .10 Finish top, bottom, edges and cutouts of doors after fitting as specified for door surfaces.
- .11 Wood, drywall, plaster, stucco, concrete, concrete masonry units and brick; if sprayed, must be back rolled.

3.6 MECHANICAL/ELECTRICAL EQUIPMENT

- .1 Paint finished area exposed conduits, piping, hangers, ductwork and other mechanical and electrical equipment with colour and finish to match adjacent surfaces, except as indicated.
- .2 Boiler room, mechanical and electrical rooms: paint exposed conduits, piping, hangers, ductwork and other mechanical and electrical equipment.
- .3 Other unfinished areas: leave exposed conduits, piping, hangers, ductwork and other mechanical and electrical equipment in original finish and touch up scratches and marks.
- .4 Do not paint over nameplates.
- .5 Keep sprinkler heads free of paint.
- .6 Paint inside of ductwork where visible behind grilles, registers and diffusers with primer and one coat of matt black paint.
- .7 Paint fire protection piping red.
- .8 Paint disconnect switches for fire alarm system and exit light systems in red enamel.
- .9 Paint natural gas piping yellow.
- .10 Paint both sides and edges of backboards for telephone and electrical equipment before installation. Leave equipment in original finish except for touch-up as required, and paint conduits, mounting accessories and other unfinished items.
- .11 Do not paint interior transformers and substation equipment.

3.7 SITE TOLERANCES

- .1 Walls: no defects visible from a distance of 1000 mm at 90 degrees to surface.
- .2 Ceilings: no defects visible from floor at 45 degrees to surface when viewed using final lighting source.
- .3 Final coat to exhibit uniformity of colour and uniformity of sheen across full surface area.

3.8 FIELD QUALITY CONTROL

- .1 Standard of Acceptance:
 - .1 Walls: no defects visible from a distance of 1000 mm at 90 degrees to surface.
 - .2 Ceilings: no defects visible from floor at 45 degrees to surface when viewed using final lighting source.
 - .3 Final coat to exhibit uniformity of colour and uniformity of sheen across full surface area.
- .2 Advise DCC Representative when surfaces and applied coating is ready for inspection. Do not proceed with subsequent coats until previous coat has been approved.

3.9 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.
 - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment.

3.10 RESTORATION

- .1 Clean and re-install hardware items removed before undertaken painting operations.
- .2 Remove protective coverings and warning signs as soon as practical after operations cease.
- .3 Remove paint splashings on exposed surfaces that were not painted. Remove smears and spatter immediately as operations progress, using compatible solvent.
- .4 Protect freshly completed surfaces from paint droppings and dust to approval of DCC Representative. Avoid scuffing newly applied paint.
- .5 Restore areas used for storage, cleaning, mixing and handling of paint to clean condition as approved by DCC Representative.

END OF SECTION

Part 1 General

1.1 REFERENCE STANDARDS

- .1 ASTM International (ASTM):
 - .1 ASTM A 153/A 153M-16a, Standard Specification for Zinc Coating (Hot Dip) on Iron and Steel Hardware
 - .2 ASTM A 307-21, Standard Specification for Carbon Steel Bolts and Studs, 60,000 psi Tensile Strength
 - .3 ASTM A 490M-12, Standard Specification for High Strength Steel Bolts, Classes 10.9 and 10.9.3, for Structural Steel Joints
 - .4 ASTM A 653/A 653M-18, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
 - .5 ASTM A 792/A 792M-21a, Standard Specification for Steel Sheet, 55% Aluminum-Zinc Alloy-Coated by the Hot-Dip Process
 - .6 ASTM D 523-14, Standard Test Method for Specular Gloss
 - .7 ASTM D 822-13, Standard Practice for Filtered Open-Flame Carbon-Arc Exposures of Paint and Related Coatings
 - .8 ASTM F 3125/F 3125M-22, Standard Specification for High Strength Structural Bolts and Assemblies, Steel and Alloy Steel, Heat Treated, Inch Dimensions 120 ksi and 150 ksi Minimum Tensile Strength, and Metric Dimensions 830 MPa and 1040 MPa Minimum Tensile Strength
- .2 CSA Group (CSA):
 - .1 CSA G40.20/G40.21-13, General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steel
 - .2 CSA S16:19, Design of Steel Structures
 - .3 CSA W59-18, Welded Steel Construction (Metal Arc Welding)
- .3 Canadian Sheet Steel Building Institute (CSSBI):
 - .1 CSSBI 30M-17, Standard for Steel Building Systems
 - .2 CSSBI Bulletin B15-17A, Snow, Wind and Earthquake Load Design Criteria for Steel Building Systems
 - .3 CSSBI Sheet Steel Fact Sheet #3-17, Care and Maintenance of Prefinished Sheet Steel Building Products
 - .4 CSSBI S8-18: Quality and Performance Specification for Prefinished Sheet Steel Used for Building Products
- .4 Health Canada/Workplace Hazardous Materials Information System (WHMIS):
 - .1 Safety Data Sheets (SDS)
- .5 The Master Painters Institute (MPI):
 - .1 Architectural Painting Specification Manual, current edition.
 - .1 MPI #23, Oil Alkyd Primer

- .2 MPI #79, Alkyd. Anti-Corrosive for Metal
- .6 Sheet Metal and Air Conditioning Contractor's National Association (SMACNA):
 - .1 SMACNA 008-2007, IAQ Guideline for Occupied Buildings under Construction
- .7 ULC Standards (ULC):
 - .1 CAN/ULC-S107:2019, Standard Methods of Fire Tests of Roof Coverings

1.2 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, product literature and data sheets for metal building materials and include product characteristics, performance criteria, physical size, finish and limitations.
 - .2 Submit WHMIS SDS. Indicate VOC's:
 - .1 For sealant materials during application and curing.
 - .2 For adhesives.
- .3 Shop Drawings:
 - .1 Submit drawings stamped and signed by professional engineer registered or licensed in Ontario, Canada.
 - .2 Indicate on drawings related provisions required for mechanical, electrical and other work.
 - .3 Submit erection drawings in accordance with CSSBI 30M as follows:
 - .1 Erection drawings showing foundation loads, anchor bolt setting details.
 - .2 Submit description of methods and sequence of erection proposed for use in erecting structural frame.
 - .3 Indicate details including cuts, copes, connections, holes, threaded fasteners, rivets and welds. Indicate welds by CSA welding symbols.

1.3 QUALITY ASSURANCE

- .1 Provide certification from pre-engineered steel building systems manufacturer that erector is qualified to erect system.

1.4 DELIVERY, STORAGE, AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements.
- .2 Delivery and Acceptance Requirements: Deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Protect prefinished steel sheet during fabrication, transportation, site storage and installation in accordance with CSSBI Sheet Steel Fact Sheet #3.

- .2 Handle and protect galvanized materials from damage to zinc coating.
 - .1 During storage space surfaces of galvanized materials to permit free circulation of air.
- .3 Store materials off ground and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
- .4 Store and protect metal building materials from nicks, scratches, and blemishes.

Part 2 Products

2.1 SYSTEM DESCRIPTION

- .1 Type: rigid frame.
- .2 Roof Slope: minimum 2/12.
- .3 Wall System: sandwich panels.
- .4 Roof System: standing seam, sandwich panels.

2.2 DESIGN CRITERIA

- .1 Design steel building system to withstand dead loads and live loads including sprinklers, mechanical and electrical systems, cranes, material handling systems, as indicated.
- .2 Maximum deflection:
 - .1 Roof cladding under full design load: 1/180 of clear span.
 - .2 Wall cladding under specified wind effects: 1/90 of clear span.
- .3 Thermal resistance: minimum R13+ R19 continuous for walls and minimum R25+R11 LS for roof.
- .4 Design building walls and roof to allow for thermal movement of component materials caused by ambient temperature range of 75°C without causing buckling, failure of joint seals, undue stress on fasteners or other detrimental effects.
- .5 Ensure building is weathertight.
- .6 Provide for positive drainage to exterior of condensation occurring within wall construction and water entering at joints.
- .7 Design building enclosure elements to accommodate, by means of expansion joints, any movement in element itself and between element and building structure caused by structural movements without permanent distortion, damage to infills, racking of joints, breakage of seals, water penetration or glass breakage.
- .8 Design of two new crane rails inside building to receive new overhead 4 tonne bridge crane. Coordinate with Crane Supplier.

2.3

2.4 MATERIALS

- .1 Structural Steel: To CSA G40.20/G40.21, shop primed.
- .2 Bolts: To ASTM F 3125/F 3125M complete with nuts and washers.
- .3 Welding materials: To CSA W59.
- .4 Shop Primer Paint: To MPI #23, Type Epoxy/zinc
- .5 Steel Sheet, Zinc-coated: To ASTM A 653/A 653M, structural quality grade A with Z275 coating, regular spangle surface, passivated for unpainted finish and unpassivated for paint finish.
- .6 Screws: Corrosion resistant purpose made, head colour to match attached sheet.
- .7 Plastic sealants and adhesives as recommended by plastics manufacturer.
- .8 Insulation: extruded polystyrene
- .9 Insulation Adhesive: Purposely made for insulation type and steel liner sheet, incombustible after initial set.
- .10 Vapour Barrier and Sealing Tape: As recommended by steel building systems manufacturer.
- .11 Sealants: as recommended by sealant manufacturer.
 - .1 Adhesives and Sealants: VOC limit 30 g/l maximum.

2.5 COMPONENTS

- .1 Wall System:
 - .1 Exterior sheet-wall: Factory preformed steel sheet, zinc coated prefinished from manufacturer's standard profiles. Include closures, gaskets, sealants, flashing and fasteners to effect weathertight installation.
 - .1 Cut ends of sheets square and clean.
 - .2 Exterior corners-wall: of material to match finish of adjacent cladding material, shop cut and brake formed to correct angle.
 - .3 Accessories to exterior wall cladding, brake or bend to shape, of material and finish to match wall cladding, comprising cap flashings, drip flashings, internal corner flashings, copings and closures for head, jamb, sill corners.
 - .4 Interior liner sheet-wall: factory preformed steel sheet, minimum 24 ga base metal thickness, zinc coated of manufacturer's standard profile ,with interlocking side lap. Install sealant material in interlocking lap.
 - .1 Cut ends of sheets square and clean.

- .5 Sub-girts and clips: Factory preformed steel sheet minimum 24 ga base metal thickness, zinc coated or aluminum-zinc alloy coated.
- .2 Roof System:
 - .1 Exterior sheet-roof: To CSSBI S8, factory preformed steel sheet zinc coated from manufacturer's standard profiles. Include closures, gaskets, sealants, flashing and fasteners to effect weathertight installation.
 - .1 Cut ends of sheets square and clean.
 - .2 Accessories to roof cladding: brake or bend to shape, of material and finish to match roof cladding or wall cladding where applicable, comprising cap flashings, drip flashings, coping and closures for corners, fascia, soffit.
 - .3 Sub-purlins and clips: factory preformed steel sheet minimum 24 ga base metal thickness, zinc coated.
 - .4 Provide snow guard system both sides entire length
- .3 Crane Rails:
 - .1 Provide 2 crane rails including connections to new mainframe columns. Coordinate with crane contractor for new 4 tonne bridge crane.
- .4

2.6 FABRICATION

- .1 Fabricate structural members in accordance with shop drawings and to CSA S16.
 - .1 Tolerance to CSSBI 30M
- .2 Provide holes for attachment of other work, as indicated.
- .3 Reinforce openings to maintain design strength.

2.7 FINISHES

- .1 Clean, prepare surfaces and shop prime structural steel to CSA S16 except where members are zinc coated.
- .2 Prefinished steel with factory applied polyvinylidene fluoride.
 - .1 Class F1S.
 - .2 Colour selected by DCC Representative from manufacturer's standard range.
 - .3 Specular gloss: 15 units +/-5 in accordance with ASTM D 523.
 - .4 Coating thickness: not less than 22 micrometers.
 - .5 Resistance to accelerated weathering for chalk rating of 8, colour fade 5 units or less and erosion rate less than 20 % to ASTM D 822 as follows:
 - .1 Outdoor exposure period 2500 hours.
 - .2 Humidity resistance exposure period 5000hours.

Part 3 Execution

3.1 EXAMINATION

- .1 Verification of Conditions: Verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for metal building installation in accordance with manufacturer's written instructions.
 - .1 Inform DCC Representative of unacceptable conditions immediately upon discovery.
 - .2 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from DCC Representative.

3.2 ERECTION

- .1 Do work in accordance with CSSBI 30M except where specified otherwise.
- .2 Erect structural frame in accordance with shop drawings and to CSA S16.
 - .1 Erection tolerances not to exceed those specified in CSSBI 30M.
- .3 Prepare galvanized structural steel surfaces for site welding by removing zinc before welding.
 - .1 After welding, chip away flux and prime with MPI #23.
- .4 Obtain written permission from DCC Representative before site cutting or altering of structural members.
- .5 Touch-up with shop primer bolts, rivets, welds and burned or scratched surfaces where exposed at completion of erection.
- .6 Install wall cladding assemblies ensuring completed installation.
- .7 Secure sub-girts to structural wall supports.
- .8 Secure roof cladding sheets to structural purlins.
 - .1 Terminate sheet ends over structural supports.
- .9 Secure side laps.
- .10 Continuously seal end and side laps.
- .11 Install roof assemblies ensuring completed installation.
- .12 Install necessary closures, gaskets, sealants and flashings.
- .13 Install insulation and vapour retarder to maintain continuity of thermal and moisture protection to building elements and spaces.
- .14 Fit insulation closely around and behind electrical boxes, pipes, ducts, frames and other objects in or passing through insulation.
- .15 Keep insulation away from hot surfaces chimneys and gas vents.

- .16 Do not compress insulation to fit into spaces.

3.3 SITE QUALITY CONTROL

.1 Manufacturer's Services:

- .1 Obtain written report from manufacturer verifying compliance of work, in handling, installing, applying, protecting and cleaning of product and submit Manufacturer's Site Reports as described in PART 1 - SUBMITTALS.
- .2 Provide manufacturer's site services consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturer's instructions.
- .3 Schedule site visits, to review work, as directed in PART 1 - QUALITY ASSURANCE.

END OF SECTION

Part 1 General

1.1 SCOPE OF WORK

- .1 Supply and install one (1) complete overhead (electric trolley electric chain hoist) top running bridge crane systems as mentioned below. Any other requirements not set forth in these specifications, but necessary for the safe and reliable operation of the equipment, shall be included.
 - .1 One 4 tonne capacity over Dry Well in the proposed superstructure to lift the pumps including motors.
- .2 Contractor shall furnish on this order:
 - .1 All material necessary for complete installation of the above-mentioned cranes including runway beams, hangers and clamps.
 - .2 Complete controls.
 - .3 Equipment operating instructions
 - .4 Drawings and parts lists as specified
 - .5 The complete system, including the installation, must conform to the applicable requirements of the latest edition of the following:
 - .1 Occupational Safety and Health Act (OSHA)
 - .2 American Gear Manufacturers Standards (AGMA)
 - .3 American National Standards Institute (ANSI)
 - .4 B30.10 . Hooks
 - .5 B30.16 . Overhead Hoists (underhung)
 - .6 B30.17 . Overhead and Gantry Cranes (top running bridge, single girder, underhung hoist)
 - .6 Contractor shall furnish the materials and labour for the following:
 - .1 Complete erection.
 - .2 Steel runway beams.
 - .3 Steel runway beam support systems as per contract drawings.
 - .4 Electric power service as required.

1.2 RELATED SECTIONS

- .1 Section 13 34 19 – Metal Building Systems

1.3 REFERENCES

- .1 The following is a list of standards which may be referenced in this Section:
 - .1 American National Standards Institute (ANSI):
 - .1 B30.10, Hooks.
 - .2 B30.11, Monorails and Underhung Cranes.
 - .3 HST 1M, Performance Standard for Electric Chain Hoists

- .4 HST 2M, Performance Standard for Hand Chain Manually Operated Chain Hoists.
- .5 MH27.1, Underhung Cranes and Monorail Systems.
- .2 Canadian Standards Association:
 - .1 CSA C22.1, Canadian Electrical Code, Part I (20th Edition).
 - .2 CSA C22.2 No. 33-M1984 (R2004), Construction and Test of Electric Cranes and Hoists.
- .3 National Electrical Manufacturer's Association (NEMA):
 - .1 MG 1, Motors and Generators.
 - .2 250, Enclosures for Electrical Equipment (1,000 volts maximum).
- .4 Electrical Equipment Manufacturers Advisory Council (EEMAC):
 - .1 M1-7, Motors and Generators.
- .5 National Fire Protection Association (NFPA): 2005 National Electrical Code (NEC) (NFPA 70):
 - .1 Article 610, Cranes and Hoists.

1.4 DESIGN REQUIREMENTS

- .1 Overhead Crane System: Specifications for Overhead and gantry Crane, ANSI MH27.1 and ANSI B30.17.
- .2 Hoist: ANSI B30.11, Hoist Manufacturers' Institute.
- .3 Trolley: ANSI MH27.1.
- .4 Chain Hoist Service Class: ANSI HST 1M.
- .5 Hook: ANSI 30.10.

Stress and Safety Factors: ANSI MH27.1 and ANSI B30.11. Properly select materials of construction for stresses to which subjected.
- .6 Safety of Operation, Accessibility, Interchangeability, and Durability of Parts: ANSI B30.17 and OSHA requirements.

1.5 SUBMITTALS

- .1 Submit certified Shop Drawings in accordance with Section 01 33 00 – Submittal Procedures.
- .2 Submit the following:
 - .1 Manufacturer's name and catalogue number of any equipment to be furnished not manufactured by vendor.
 - .2 Any exception or difference of any equipment to be furnished from that specified and reason for the substitution.
 - .3 Name and address of manufacturer's representative nearest CFB Trenton maintaining 24-hour service facilities and complete stock of spare parts.

- .4 Supply spare parts as required for one year's maintenance.
- .5 Installation, operation, maintenance and lubrication manuals.
- .6 Shop drawing for the crane beam support systems sealed and signed by a professional Engineer registered in the Province of Ontario.

Part 2 Products

2.1 DESIGN CONDITIONS

- .1 The equipment will be operated in ambient temperatures ranging from 5°C to 40°C.
- .2 All bearings in trolley and hoist shall be lifetime lubricated.
- .3 Each hoist and chain shall be load tested to 125% capacity and test certificates shall be submitted to Contract Administrator.
- .4 Size of crane beams and connections as per pre-eng. building design.
- .5 Other design conditions:

Parameter	Value
Crane Type	Top running bridge
Capacity rating (kg)	4 Tonne
Type of Trolley	Motorized
Monorail length(m)	As shown on structural drawings
Beam Size	As per pre-eng. design
Total lift (m)	9
Hoist	Motorized
Chain	Stainless Steel

2.2 ELECTRICAL REQUIREMENTS

- .1 All power supply shall be 600 V, 3 Phase, 60 Hz alternating current.
- .2 Supply and install all necessary wiring to connect all parts to the equipment to the junction boxes installed by the electrical trade. All wiring shall be installed in accordance with the Canadian Electrical Code.
- .3 All controls from hoists, trolleys etc., where electrified shall be of the pendent push- button type and shall operate on 120V, single phase, 60 Hz power alternating current.

Part 3 Execution

3.1 EQUIPMENT DESIGN SAFETY

- .1 All equipment furnished to vendor's standard design, which incorporates weld elements, is to be welded in accordance with the appropriate codes and standards of the Canadian Welding Bureau and Canadian Standards Association.
- .2 All equipment non-standard design to fulfill special requirements shall, in addition, meet the following:
 - .1 All critical welds, the failure of which would cause potential accidents or injuries to personnel, are to be executed with special attention as outlined in this section.
 - .2 An audit is to be made by the vendor to determine those welds to be in the critical category. Such welds are to be given special attention by the vendor to insure adequate quality control.

3.2 INSTALLATION

- .1 Before leaving the factory the crane and hoist shall be tested under all motions.
- .2 Install the equipment described above in accordance with the drawings and with strict adherence to the manufacturer's instructions.
- .3 Ensure that the crane rails are perfectly horizontal, correctly aligned, and properly fastened to the supporting structures. Install the travel limits stops on each end of rails.
- .4 Lubricate all necessary points on the as per manufacturer's recommended lubricates.

3.3 PAINTING AND FINISHING

- .1 The crane assembly shall receive one shop coat of high visibility yellow epoxy paint.
- .2 All exposed surfaces of crane to be painted after installation.
- .3 The capacity of crane systems shall be clearly painted on the side of the crane beam.

3.4 INSPECTION AND TESTS

- .1 Do performances test on each hoist and monorail systems.
- .2 Load tests in compliances with OSHA, ANSI B30.17, and ANSI MH27.1.
- .3 Final acceptance will be made after the entire installation and testing has been completed. All tests required to prove the ability of the crane shall be made by the Contractor. A vendor's representative is invited to attend.

3.5 GUARANTEE

- .1 Vendor shall guarantee all materials and workmanship of equipment installed under these specifications for a period of one (1) years after installation.

National Defence
8 Wing Trenton
Project No: 500006750

Overhead Crane

Section 14 63 00
Page 5
2025-11-20

END OF SECTION

Part 1 General

1.1 REFERENCE STANDARDS

- .1 National Fire Protection Association
 - .1 NFPA 20 – Standard for the Installation of Stationary Pumps for Fire Protection
 - .2 NFPA 22 – Standard for Water Tanks for Private Fire Protection

1.2 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for review and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Shop Drawings:
 - .1 Submit drawings stamped and signed by professional engineer registered or licensed in Ontario, Canada.
 - .2 Indicate on drawings:
 - .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.

1.3 CLOSEOUT SUBMITTALS

- .1 Submit in accordance with Section 01 78 00 - Closeout Submittals.
- .2 Operation and Maintenance Data: submit operation and maintenance data for review and for incorporation into manual.
 - .1 Operation and maintenance manual approved by, and final copies deposited with, DCC Representative before final inspection.
 - .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 instruction for systems and component.
- .5 Description of actions to be taken in event of equipment failure.
- .6 Valves schedule and flow diagram.
- .7 Colour coding chart.
- .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 complete.
 - .2 Equipment performance verification test results.
 - .3 Special performance data as specified.
- .5 Approvals:
 - .1 Submit 2 copies of draft Operation and Maintenance Manual to DCC Representative for approval. Submission of individual data will not be accepted unless directed by DCC Representative.
 - .2 Make changes as required and re-submit as directed by DCC Representative.
- .6 Additional data:
 - .1 Prepare and insert into operation and maintenance manual additional data when need for it becomes apparent during specified demonstrations and instructions.
- .7 Site records:
 - .1 DCC Representative will provide 1 set of reproducible mechanical drawings. Provide sets of white prints as required for each phase of work. Mark changes as work progresses and as changes occur. Include changes to existing mechanical systems, control systems and low voltage control wiring.
 - .2 Transfer information weekly to reproducibles, revising reproducibles to show work as actually installed.
 - .3 Use different colour waterproof ink for each service.
 - .4 .4 Make available for reference purposes and inspection.
- .8 As-Built drawings:
 - .1 Prior to start of Testing, Adjusting and Balancing for HVAC, finalize production of as-built drawings.
 - .2 Identify each drawing in lower right hand corner in letters at least 12 mm high as follows: "AS BUILT DRAWINGS: THIS DRAWING HAS BEEN REVISED TO SHOW MECHANICAL SYSTEMS AS INSTALLED" (Signature of Contractor) (Date).
 - .3 Submit to DCC 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.
- .9 Submit copies of as-built drawings for inclusion in final TAB report.

1.4 MAINTENANCE MATERIAL SUBMITTALS

- .1 Submit in accordance with Section 01 78 00 - Closeout Submittals.
- .2 Furnish spare parts as follows:
 - .1 One set of packing for each pump.
 - .2 One casing joint gasket for each size pump.
 - .3 One glass for each gauge glass.
- .3 Provide one set of special tools required to service equipment as recommended by manufacturers and in accordance with Section 01 78 00 - Closeout Submittals.
- .4 Furnish one commercial quality grease gun, grease and adapters to suit different types of grease and grease fittings.

1.5 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store materials in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect equipment from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.
- .4 Develop Construction Waste Management Plan related to Work of this Section.
- .5 Packaging Waste Management: remove for reuse and return by manufacturer of pallets, crates, padding, and packaging materials as specified in Section 01 74 19 Waste Management and Disposal.

Part 2 Products

2.1 MATERIALS

- .1 Not used.

Part 3 Execution

3.1 EXAMINATION

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

- .1 Visually inspect substrate in presence of DCC Representative.
- .2 Inform DCC Representative of unacceptable conditions immediately upon discovery.
- .3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from DCC Representative.

3.2 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.

3.3 SYSTEM CLEANING

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

3.4 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 - ACTION AND INFORMATIONAL 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 - ACTION AND INFORMATIONAL SUBMITTALS.
 - .2 Provide manufacturer's field services consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturer's instructions.

3.5 DEMONSTRATION

- .1 DCC Representative will use equipment and systems for test purposes prior to acceptance. Supply labour, material, and instruments required for testing.
- .2 Trial usage to apply to following equipment and systems.
 - .1 Fire pumps.
 - .2 Heating.
 - .3 Ventilation.
- .3 Supply tools, equipment and personnel to demonstrate and instruct operating and maintenance personnel in operating, controlling, adjusting, trouble-shooting and servicing of all systems and equipment during regular work hours, prior to acceptance.
- .4 Use operation and maintenance manual, as-built drawings, and audio visual aids as part of instruction materials.
- .5 Instruction duration time requirements as specified in appropriate sections.
- .6 DCC Representative will record these demonstrations on video tape for future reference.

3.6 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.
 - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.
- .3 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 19 Waste Management and Disposal.
 - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

3.7 PROTECTION

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

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 23 05 19.13 - Thermometers and Pressure Gauges - Piping Systems.

1.2 REFERENCE STANDARDS

- .1 National Fire Prevention Association (NFPA)
 - .1 [NFPA 13-2022](#), Standard for the Installation of Sprinkler Systems.
 - .2 [NFPA 20-2022](#), Standard for the Installation of Stationary Pumps for Fire Protection.
 - .3 [NFPA 24-2022](#), Standard for the Installation of Private Fire Service Mains and Their Appurtenances.
 - .4 [NFPA 25-2020](#), Standard for the Inspection, Testing, and Maintenance of Water-Based Fire Protection Systems.
- .2 Underwriter's Laboratories of Canada (ULC)
 - .1 CAN/ULC-S543-2009(R2021), Standard for Internal Lug Quick Connect Couplings for Fire Hose.

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 data sheets, and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Shop Drawings:
 - .1 Submit drawings stamped and signed by professional engineer registered or licensed in the Province of Ontario, Canada.
 - .2 Indicate:
 - .1 Materials.
 - .2 Finishes.
 - .3 Method of anchorage
 - .4 Number of anchors.
 - .5 Supports.
 - .6 Reinforcement.
 - .7 Assembly details.
 - .8 Accessories.
- .4 Test reports:
 - .1 Submit certified test reports for wet pipe fire protection sprinkler systems 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:
 - .1 Provide manufacturer's installation instructions.
- .7 Field Quality Control Submittals:
 - .1 Manufacturer's Field Reports: manufacturer's field reports specified.

1.4 CLOSEOUT SUBMITTALS

- .1 Provide operation, maintenance and engineering data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals in accordance with ANSI/NFPA 20.
- .2 Manufacturer's catalogue Data, including specific model, type, and size for:
 - .1 Pipe and fittings.
 - .2 Alarm valves.
 - .3 Valves, including gate, check, and globe.
 - .4 Water motor alarms.
 - .5 Sprinkler heads.
 - .6 Pipe hangers and supports.
 - .7 Pressure or flow switch.
 - .8 Fire department connections.
 - .9 Excess pressure pump.
 - .10 Mechanical couplings.
- .3 Drawings:
 - .1 Sprinkler heads and piping system layout.
 - .1 Prepare 760 mm by 1050 mm detail working drawings of system layout in accordance with [NFPA 13](#), "Working Drawings (Plans)".
 - .2 Show data essential for proper installation of each system.
 - .3 Show details, plan view, elevations, and sections of systems supply and piping.
 - .4 Show piping schematic of systems supply, devices, valves, pipe, and fittings.
Show point to point electrical wiring diagrams.
 - .2 Electrical wiring diagrams.
- .4 Design Data:
 - .1 Calculations of sprinkler system design.
 - .2 Indicate type and design of each system and certify that each system has performed satisfactorily in the manner intended for not less than 18 months.
- .5 Field Test Reports:
 - .1 Preliminary tests on piping system.
- .6 Records:

- .1 As-built drawings of each system.
 - .1 After completion, but before final acceptance, submit complete set of as-built drawings of each system for record purposes.
 - .2 Submit 760 mm by 1050 mm drawings on reproducible Mylar film with title block similar to full size contract drawings.
- .7 Operation and Maintenance Manuals:
 - .1 Provide detailed hydraulic calculations including summary sheet, and Contractors Material and Test Certificate for aboveground and underground piping and other documentation for incorporation into manual in accordance with [NFPA 13](#).

1.5 QUALITY ASSURANCE

- .1 Qualifications:
 - .1 Installer: company or person specializing in wet sprinkler systems with documented experience approved by manufacturer.
- .2 Supply grooved joint couplings, fittings, valves, grooving tools and specialties from a single manufacturer. Use date stamped castings for coupling housings, fittings, valve bodies, for quality assurance and traceability.

1.6 MAINTENANCE MATERIAL SUBMITTALS

- .1 Extra Materials:
 - .1 Provide maintenance materials in accordance with Section 01 78 00 - Closeout Submittals.
 - .2 Provide spare sprinklers and tools in accordance with [NFPA 13](#).

1.7 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements:
 - .1 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.
- .3 Storage and Protection:
 - .1 Store materials in dry location.
 - .2 Store and protect materials from exposure to harmful weather conditions and at temperature and humidity conditions recommended by manufacturer.
- .4 Packaging Waste Management: remove for reuse and return by manufacturer of pallets, crates, padding, and packaging materials in accordance with Section 01 74 19 Waste Management and Disposal.

Part 2 Products

2.1 DESIGN REQUIREMENTS

- .1 Design automatic wet pipe fire suppression sprinkler systems in accordance with required and advisory provisions of NFPA 13, by hydraulic calculations for uniform distribution of water over design area.
- .2 Include with each system materials, accessories, and equipment inside and outside building to provide each system complete and ready for use.
- .3 Design and provide each system to give full consideration to blind spaces, piping, electrical equipment, ducts, and other construction and equipment in accordance with detailed shop drawings.
- .4 Locate sprinkler heads in consistent pattern with ceiling grid, lights, and air supply diffusers.
- .5 Devices and equipment for fire protection service: ULC approved for use in wet pipe sprinkler systems.
- .6 Design systems for earthquake protection for buildings in seismic zones 3 and 4, and only essential and high risk buildings in seismic zone 2.
- .7 Location of Sprinkler Heads:
 - .1 Locate heads in relation to ceiling and spacing of sprinkler heads not to exceed that permitted by [NFPA 13](#) for ordinary hazard occupancy.
 - .2 Uniformly space sprinklers on branch.
- .8 Water Distribution:
 - .1 Make distribution uniform throughout the area in which sprinkler heads will open.
 - .2 Discharge from individual heads in hydraulically most remote area to be 100% of specified density.
- .9 Density of Application of Water:
 - .1 Size pipe to provide specified density when system is discharging specified total maximum required flow.
- .10 Sprinkler Discharge Area:
 - .1 Area: hydraulically most remote area as defined in [NFPA 13](#).
- .11 Outside Hose Allowances:
 - .1 Include allowance in hydraulic calculations for outside hose streams.
- .12 Friction Losses:
 - .1 Calculate losses in piping in accordance with Hazen-Williams formula with 'C' value of 120 for steel piping, 150 for copper tubing, and 140 for cement-lined ductile-iron piping.
- .13 Water Supply:
 - .1 Base hydraulic calculations on static pressure of water storage tank water elevation for fire pump building sprinklers.

2.2 ABOVE GROUND PIPING SYSTEMS

- .1 Provide fittings for changes in direction of piping and for connections.
 - .1 Make changes in piping sizes through tapered reducing pipe fittings, bushings will not be permitted.
- .2 Perform welding in shop.

2.3 PIPE, FITTINGS AND VALVES

- .1 Pipe:
 - .1 Ferrous: to [NFPA 13](#).
- .2 Fittings and joints to [NFPA 13](#):
 - .1 Ferrous: screwed, welded, flanged or roll grooved.
 - .1 Grooved joints designed with two ductile iron housing segments, pressure responsive gasket, and zinc-electroplated steel bolts and nuts. Cast with offsetting angle-pattern bolt pads for rigidity and visual pad-to-pad offset contact.
 - .2 Provide welded, threaded, grooved-end type fittings into which sprinkler heads, sprinkler head riser nipples, or drop nipples are threaded.
 - .3 Plain-end fittings with mechanical couplings and fittings which use steel gripping devices to bite into pipe when pressure is applied will not be permitted.
 - .4 Rubber gasketed grooved-end pipe and fittings with mechanical couplings are permitted in pipe sizes 32 mm and larger.
 - .5 Fittings: ULC approved for use in wet pipe sprinkler systems.
 - .6 Ensure fittings, mechanical couplings, and rubber gaskets are supplied by same manufacturer.
 - .7 Side outlet tees using rubber gasketed fittings are not permitted.
 - .8 Sprinkler pipe and fittings: metal.
- .3 Valves:
 - .1 ULC listed for fire protection service.
 - .2 Gate valves: open by counterclockwise rotation.
 - .3 Provide rising stem OS & Y valve beneath each alarm valve in each riser when more than one alarm valve is supplied from same water supply pipe and as indicated on plans.
 - .4 Check valves: flanged clear opening swing or spring actuated check type with flanged inspection and access cover plate for sizes 10 cm and larger.
- .4 Pipe hangers:
 - .1 ULC listed for fire protection services in accordance with NFPA.

2.4 SPRINKLER HEADS

- .1 General: to [NFPA 13](#) and ULC listed for fire services.
- .2 Sprinkler Head Type:
 - .1 Type A: upright bronze in areas without ceilings.

- .2 Type C: pendant chrome glass bulb type in areas with ceilings.
- .3 Provide nominal 1.2 cm orifice sprinkler heads.
 - .1 Release element of each head to be of intermediate temperature rating or higher as suitable for specific application.
 - .2 Provide polished chromium-plated finish on copper alloy ceiling plates, and chromium-plated pendent sprinklers below suspended ceilings.
 - .3 Provide corrosion-resistant sprinkler heads and sprinkler head guards in accordance with [NFPA 13](#).
 - .4 Provide sprinkler heads as indicated.
 - .5 Deflector: not more than 75 mm below suspended ceilings.
 - .6 Ceiling plates: not more than 25 mm deep.
 - .7 Ceiling cups: not permitted.

2.5 WATER MOTOR ALARMS

- .1 Provide alarms approved weatherproof and guarded type, to sound locally on flow of water in each corresponding sprinkler system.
- .2 Mount alarms on outside of outer walls of each building at location as directed.
- .3 Provide separate drain piping directly to exterior of building.

2.6 SUPERVISORY SWITCHES

- .1 General: to [NFPA 13](#) and ULC listed for fire service.
- .2 Valves:
 - .1 Mechanically attached to valve body, with normally open and normally closed contacts and supervisory capability.
- .3 Pressure or flow switch type:
 - .1 With normally open and normally closed contacts and supervisory capability.
 - .2 Provide switch with circuit opener or closer for automatic transmittal of alarm over facility fire alarm system.
 - .3 Connect into building fire alarm system.
 - .4 Connection of switch: Section 28 31 02 – Multiplex Fire Alarm System.
 - .5 Alarm actuating device: mechanical diaphragm controlled retard device adjustable from 10 to 60 seconds and instantly recycle.
- .4 Pressure alarm switch:
 - .1 With normally open and normally closed contacts and supervisory capability.

2.7 WATER GONG

- .1 To [NFPA 13](#) and ULC listed for fire service. Location as indicated.

2.8 FIRE DEPARTMENT CONNECTION

- .1 Provide connections approximately 1.5 m above finish grade, location as indicated.
- .2 To [NFPA 13](#) and ULC S543 listed, Siamese type.
- .3 Polished bronze recessed of approved two-way type with 2.5 inch National Standard female hose threads with plug, chain, and identifying fire department connection escutcheon plate.
- .4 Thread specifications: compatible with local fire department.
- .5 Install a 90-degree elbow with drain connection at the low-point near each fire department connection to allow for system drainage to prevent freezing.

2.9 PRESSURE GAUGES

- .1 ULC listed.
- .2 Maximum limit of not less than twice normal working pressure at point where installed.

2.10 BURIED WATER PIPING SYSTEM

- .1 Pipe and Fittings:
 - .1 Provide outside-coated, cement-mortar lined, ductile-iron pipe, and fittings, in accordance with [NFPA 24](#), for piping under building and outside of building walls.
 - .2 Anchor joints in accordance with [NFPA 24](#).
 - .3 Provide concrete thrust block at elbow where pipe turns up toward the floor and restrain pipe riser with steel rods from elbow to flange above floor.
 - .4 Minimum pipe size: 150 mm.
 - .5 Minimum depth of cover: 1.0 metre at finish grade.
 - .6 Piping beyond 1.5 metre outside of building walls: refer to civil documents.
- .2 Bolt and Nut for Flange:
 - .1 Galvanized Hexagon Head bolts and Hexagon nuts.
- .3 Valves:
 - .1 In accordance with [NFPA 24](#).
 - .2 Gate valves: ULC listed and opened by counterclockwise rotation.
- .4 Post Indicator Valves:
 - .1 Provide with operating nut located about 1.5 m above finish grade.
 - .2 Gate valves for use with indicator post, ULC listed.
 - .3 Indicator posts: ULC listed.
 - .4 Provide each indicator post with 1 coat of primer and two coats of red enamel paint.
- .5 Valve Boxes:
 - .1 Except where indicator posts are provided, for each buried valve, provide cast-iron, ductile-iron, plastic valve box of suitable size.

- .2 Plastic boxes: constructed of acrylonitrile butadiene styrene (ABS) inorganic fiber-reinforced black polyolefin.
- .3 Provide cast-iron cover for valve box with word English wording for "WATER" cast on cover.
- .4 Minimum box shaft diameter: 13.3 cm.
- .5 Coat cast-iron boxes with bituminous paint applied to minimum dry-film thickness of 10 ml.
- .6 Buried Utility Warning and Identification Tape:
 - .1 Provide detectable detectable magnetic plastic tape manufactured specifically for warning and identification of buried piping detectable by electronic detection instrument.
 - .2 Provide tape in rolls, 7.6 cm minimum width, colour coded in accordance with local utility, with warning and identification imprinted in bold black letters continuously and repeatedly over entire tape length.
 - .3 Warning and identification: to read "CAUTION BURIED WATER PIPING BELOW".
 - .4 Use permanent code and letter colouring unaffected by moisture and other substances contained in trench backfill material.

2.11 PIPE SLEEVES

- .1 Provide pipe sleeves where piping passes through walls, floors, and roofs.
- .2 Secure sleeves in position and location during construction.
- .3 Provide sleeves of sufficient length to pass through entire thickness of walls, floors, and roofs.
- .4 Provide 2.5 cm minimum clearance between exterior of piping and interior of sleeve or core-drilled hole.
 - .1 Firmly pack space with mineral wool insulation.
 - .2 Seal space at both ends of sleeve or core-drilled hole with mechanically adjustable segmented elastomeric seal.
 - .3 In fire walls and fire floors, seal both ends of pipe sleeves or core-drilled holes with ULC listed fill, void, or cavity material.
- .5 Sleeves in Masonry and Concrete Walls, Floors, and Roofs:
 - .1 Provide hot-dip galvanized steel, ductile-iron, cast-iron sleeves.
 - .2 Core drilling of masonry and concrete may be provided in lieu of pipe sleeves when cavities in core-drilled hole are completely grouted smooth.
- .6 Sleeves in Other Than Masonry and Concrete Walls, Floors, and Roofs:
 - .1 Provide 0.61 mm thick galvanized steel sheet.

2.12 ESCUTCHEON PLATES

- .1 Provide one piece type metal plates for piping passing through walls, floors, and ceilings in exposed spaces.
- .2 Provide polished chromium-plated finish on copper alloy plates in finished spaces.

- .3 Provide paint finish on metal plates in unfinished spaces.

2.13 INSPECTOR'S TEST CONNECTION

- .1 Locate inspector's test connection at hydraulically most remote part of each system, provide test connections approximately 3 m above floor for each sprinkler system or portion of each sprinkler system equipped with alarm device.
- .2 Provide test connection piping to location where discharge will be readily visible and where water may be discharged without property damage.
- .3 Provide discharge orifice of same size as corresponding sprinkler orifice.

2.14 SIGNS

- .1 Attach properly lettered Bilingual and approved metal signs to each valve and alarm device to [NFPA 13](#).
- .2 Permanently fix hydraulic design data nameplates to riser of each system.

2.15 SPARE PARTS CABINET

- .1 Provide metal cabinet with extra sprinkler heads and sprinkler head wrench adjacent to each alarm valve. Number and types of extra sprinkler heads as specified in [NFPA 13](#).

Part 3 Execution

3.1 MANUFACTURER'S INSTRUCTIONS

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

3.2 INSTALLATION

- .1 Install, inspect and test to acceptance in accordance with [NFPA 13](#) and [NFPA 25](#).

3.3 PIPE INSTALLATION

- .1 Install piping straight and true to bear evenly on hangers and supports. Do not hang piping from plaster ceilings.
- .2 Keep interior and ends of new piping and existing piping thoroughly cleaned of water and foreign matter.
- .3 Keep piping systems clean during installation by means of plugs or other approved methods. When work is not in progress, securely close open ends of piping to prevent entry of water and foreign matter.
- .4 Inspect piping before placing into position.

3.4 ELECTRICAL CONNECTIONS

- .1 Provide electrical work associated with this section under Section 26 05 00 - Common Work Results for Electrical.
- .2 Provide fire alarm system under Section 28 31 02 – Multiplex Fire Alarm System.
- .3 Provide control and fire alarm wiring, including connections to fire alarm systems, in accordance with National Electrical Code.
- .4 Provide wiring in rigid metal conduit or intermediate metal conduit.

3.5 DISINFECTION

- .1 Disinfect new piping and existing piping.
- .2 Fill piping systems with solution containing minimum of 50 parts per million of chlorine and allow solution to stand for minimum of 24 hours.
- .3 Flush solution from systems with clean water until maximum residual chlorine content is not greater than 0.2 part per million or residual chlorine content of domestic water supply.
- .4 Obtain at least two consecutive satisfactory bacteriological samples from piping, analyzed by certified laboratory, and submit results prior to piping being placed into service.

3.6 CONNECTIONS TO EXISTING WATER SUPPLY SYSTEMS

- .1 Notify Contracting Officer in writing at least 15 days prior to connection date.
- .2 Use tapping or drilling machine valve and mechanical joint type sleeves for connections to be made under pressure.
- .3 Bolt sleeves around main piping.
- .4 Bolt valve to branch connection. Open valve, attach drilling machine, make tap, close valve, and remove drilling machine, without interruption of service.
- .5 Furnish materials required to make connections into existing water supply systems, and perform excavating, backfilling, and other incidental labour as required.

3.7 BURIED PIPING SYSTEM

- .1 Bury tape with printed side up at depth of 30 cm below the top surface of earth or top surface of subgrade under pavements.

3.8 FIELD PAINTING

- .1 Clean, pretreat, prime, and paint new systems including valves, piping, conduit, hangers, supports, miscellaneous metalwork, and accessories.
- .2 Apply coatings to clean, dry surfaces, using clean brushes.
- .3 Clean surfaces to remove dust, dirt, rust, and loose mill scale.

- .4 Immediately after cleaning, provide metal surfaces with 1 coat of pretreatment primer applied to minimum dry film thickness of 0.3 ml, and one coat of zinc chromate primer applied to minimum dry film thickness of 1.0 ml.
- .5 Shield sprinkler heads with protective covering while painting is in progress.
- .6 Upon completion of painting, remove protective covering from sprinkler heads.
- .7 Remove sprinkler heads which have been painted and replace with new sprinkler heads.
- .8 Provide primed surfaces with following:
 - .1 Exposed Piping:
 - .1 Provide piping, valves and operating accessories with 1 coat of red alkyd gloss enamel applied to minimum dry film thickness of 1.0 mil.

3.9 FIELD QUALITY CONTROL

- .1 Site Test, Inspection:
 - .1 Perform test to determine compliance with specified requirements in presence of DCC Representative.
 - .2 Test, inspect, and approve piping before covering or concealing.
 - .3 Preliminary Tests:
 - .1 Hydrostatically test each system at 200 psig for a 2 hour period with no leakage or reduction in pressure.
 - .2 Flush piping with potable water in accordance with [NFPA 13](#).
 - .3 Piping above suspended ceilings: tested, inspected, and approved before installation of ceilings.
 - .4 Test alarms and other devices.
 - .5 Test water flow alarms by flowing water through inspector's test connection. When tests have been completed and corrections made, submit signed and dated certificate in accordance with [NFPA 13](#).
 - .4 Formal Tests and Inspections:
 - .1 Do not submit request for formal test and inspection until preliminary test and corrections are completed and approved.
 - .2 Submit written request for formal inspection at least 15 days prior to inspection date.
 - .3 Repeat required tests as directed.
 - .4 Correct defects and make additional tests until systems comply with contract requirements.
 - .5 Furnish appliances, equipment, instruments, connecting devices, and personnel for tests.
 - .6 Authority of Jurisdiction, will witness formal tests and approve systems before they are accepted.
- .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 - ACTION AND INFORMATIONAL SUBMITTALS.
 - .2 Provide manufacturer's field services consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturer's instructions.
 - .3 Schedule site visits, to review Work, as directed in PART 1 - QUALITY ASSURANCE.
- .3 Site Tests:
- .1 Field test each fire pump, driver and controllers in accordance with [NFPA 20](#). Testing shall include:
 - .1 Verification of proper installation, system initiation, adjustment and fine tuning.
 - .2 Verification of the sequence of operations and alarm systems.
 - .2 Testing to be witnessed by authority having jurisdiction.
 - .3 Develop, with DCC Representative assistance, detailed instructions for O & M of this installation.

3.10 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 19 Waste Management and Disposal.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 21 05 00 Common Work Results for Fire Suppression.

1.2 REFERENCE STANDARDS

- .1 National Fire Protection Association (ANSI/NFPA)
 - .1 [NFPA 20-2022](#), Standard for the Installation of Stationary Fire Protection.
- .2 Underwriters' Laboratories of Canada (ULC)

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's printed product literature, specifications and datasheet for fire pump control and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Shop Drawings:
 - .1 Submit drawings for fire pump controller stamped and signed by professional engineer registered or licensed in Ontario, Canada.
 - .2 Indicate:
 - .1 Method of anchorage
 - .2 Number of anchors.
 - .3 Supports.
 - .4 Reinforcement.
 - .5 Assembly details.
 - .6 Accessories.
 - .7 Indicate hydraulic and electrical characteristics including Net Positive Suction Head (NPSH) required, make and model number.
 - .3 Provide power and control diagrams.

1.4 CLOSEOUT SUBMITTALS

- .1 Submit maintenance and engineering data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals in accordance with ANSI/NFPA 20.

1.5 EXTRA MATERIALS

- .1 Extra Materials:
 - .1 Furnish spare parts for each pump in accordance with Section 01 78 00 - Closeout Submittals and as follows:
 - .2 One set of packing.

- .3 One casing joint gasket.

1.6 QUALITY ASSURANCE

- .1 Quality Assurance: in accordance with Section 01 45 00 - Quality Control.
 - .1 Test reports:
 - .1 Submit certified test reports for packaged fire pumps from approved independent testing laboratories, indicating compliance with specifications for specified performance characteristics and physical properties.
 - .2 Test each pump/driver package at factory to provide detailed performance data and to demonstrate compliance with NFPA and specification. Submit certified test curves for approval of DCC Representative.
 - .3 Test hydrostatically to meet requirements of fire protection system to which it will be connected.
 - .2 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
 - .3 Instructions: submit manufacturer's installation instructions.
 - .4 Manufacturer's Field Reports: manufacturer's field reports specified.
- .2 Qualifications:
 - .1 Installer: company or person specializing in packaged fire pump installations approved by manufacturer.

1.7 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 Packaging Waste Management: remove for reuse and return by manufacturer of pallets, crates, padding and packaging materials in accordance with Section 01 74 19 Waste Management and Disposal.

Part 2 Products

2.1 SYSTEM DESCRIPTION

- .1 Design Requirements:
- .2 Select fire pump to satisfy fire protection system requirements and [NFPA 20](#).
- .3 Water supply:
 - .1 Below grade water storage reservoir sized for 45 minutes of water flow, 378 L/s total system flow, 848kPa at connection to Hangar 10 water main. Three duty pumps in parallel plus one standby pump and one jockey pump.

2.2 FIRE PUMP

- .1 Packaged, ULC, CSA listed and labelled vertical turbine fire pump and controller.
- .2 Driver: diesel internal combustion engine complete with storage batteries, starting equipment and controls.
- .3 Materials and construction: to [NFPA 20](#). Listed by Underwriters Laboratories of Canada (ULC), Underwriters Laboratories Inc. (UL) and approved by Factory Mutual (FM)
- .4 Capacity: as indicated to satisfy fire protection system requirements and NFPA:
 - .1 Flow rate: 126 L/s.
 - .2 Pressure: 860 kPa.

2.3 BOWL ASSEMBLY

- .1 The pump bowl assembly shall be of close grain, cast iron ASTM A48 class 30 threaded or flanged.
- .2 A minimum of one-half inch diameter high tensile bolting shall be employed on flanged bowls. The water passages shall be lined with porcelain enamel to reduce friction losses, shall be free of blow holes, sand holes and other detrimental defects, and shall be accurately machined and fitted with bowl wear rings of bronze ASTM B505 alloy 943 or 954.
- .3 The impellers shall be of bronze ASTM B584 alloy 83800 enclosed and dynamically balanced. Impellers shall be securely fastened to the shaft with taper split bushings of steel. Impellers shall be adjusted vertically by an external means.
- .4 The pump shaft shall be A582 grade 416 stainless steel, turned, ground and polished. It shall be supported by bronze bearings of ASTM B505 alloy C84400 above and below each impeller. The suction bearing shall be grease lubricated of the same material as the bowl bearing and be protected by a bronze sand collar of ASTM B584 alloy C83800. The size of the shaft shall be no less than that determined by ANSI/AWWA Specifications E101, Section A4.3, paragraph 4.3.3.
- .5 The discharge case when used shall be threaded on the outside and fitted with a cast iron ASTM A48 Class 30 column adapter of the proper size to connect to the column selected.
- .6 The suction case shall be fitted with a corrosion resistant cone strainer with free area equal to four times the inlet area.

2.4 COLUMN ASSEMBLY

- .1 The unit shall be supplied with a column assembly to lengthen the pump so that the second impeller from the bottom is submerged at least 10 feet below the pumping water level at 150 percent to rated capacity. One foot additional submergence shall be added for each 1,000 feet of elevation above sea level.
- .2 The column size shall be such that friction loss will not exceed 5' per 100' based on the rated capacity of the pump. If possible, the column size shall also be such as to provide a velocity of not less than 5' per second at the rated capacity.

- .3 The outer column pipe shall be ASTM A53 grade B steel pipe or ASTM A120 in interchangeable sections not over 10' in length. All joints shall be connected with threaded sleeve type couplings or flanges. Flanges shall have a rabbet fit to insure accurate column alignment. Threaded sections shall be faced parallel and machined with 8 straight threads per inch permitting the ends to butt against the bearing retainer shoulder insure proper alignment and to secure the bearing retainer when assembled. The weight of the column pipe shall be no less than that stated in NFPA-20, Table 2 no. 4-3.2 "Pump Column Weights".
- .4 The line shafts shall be of carbon steel ASTM A108 grade C1045, turned and ground. They shall be furnished in interchangeable sections not over (10) feet in length. The butting faces shall be machined square to the axis of the shaft, with maximum permissible axial misalignment of the thread axis with the shaft axis 0.002" in 6". The size of the shaft shall be no less than that determined by ANSI/AWWA E101 Specifications, Section 5.5 for C1045 line shaft selection and shall be such that elongation due to hydraulic thrust will not exceed the axial clearance of the impellers in the pump bowls. Maximum run-out in 10' shall not exceed .005".
- .5 The line shafts shall be provided with ASTM A269 grade 304 stainless steel sleeves at the location of each line shaft bearing. The line shaft bearing shall be of 70 minimum shore hardness, neoprene, snap-in type, internally spiral grooved to flush out sand and other abrasives, mounted in ductile iron ASTM A536-77 bearing retainers held in position in the column coupling by means of the butted ends of the column pipe. Bearing spacing shall not exceed 10'. The line shafts shall be coupled with steel couplings ASTM A108, grade 1215 machined from solid bar stock and designed with safety factor of 1-1/2 times that of the line shaft. Each coupling shall have an inspection hole drilled in the center to assist in centering the line shafts in the coupling.

2.5 DISCHARGE HEAD ASSEMBLY

- .1 The discharge head shall be cast iron ASTM A48 Class 30 free of sand holes and other defects, or type "F" fabricated of carbon steel materials using ASTM A181 flanges, ASTM A53 Grade B body pipe and ASTM A36 steel plate and accurately machined with a rabbet fit on top to receive the driver. The discharge head shall be fitted with a 125/150# discharge flange where the shut-off head is 175 psi or less or a 250/300# flange where the shut-off pressure is between 175 and 400 psi. Flanges shall be arranged for through bolting and of the size shown on the plans.
- .2 The standard cast iron stuffing box shall be rated for 150# discharge pressure and shall be fitted with graphite acrylic packing and have either a lantern ring or grease chamber below the first packing ring. Throttle bearing shall be of high lead bronze ASTM B505 alloy C84400. The packing gland shall be of bronze ASTM B584 alloy C83800 with stainless steel bolting and with brass or stainless steel adjusting nuts. Sealing between the stuffing box and the discharge head shall be accomplished by means of and "O" ring.
- .3 If discharge pressure exceeds 150 psi, a high pressure by pass style packing box shall be supplied with a minimum of six rings of packing and two lantern rings, and a bypass line.
- .4 The top line shaft shall be ASTM A582 Grade 416 stainless steel and shall not exceed 10 feet in length. Impeller adjustment shall be provided at the top of the head shaft by means of a bronze adjusting nut of ASTM B584 alloy C83800 which shall be positively locked in position. The head shaft shall also be 416SS and shall be connected to the top line shaft beneath the driver to facilitate ease of assembly and maintenance.
- .5 The discharge head shall be fitted with an easily removable wire mesh shaft guard.

2.6 DIESEL ENGINE

- .1 The pump shall be direct coupled through flexible coupling to a diesel engine, specifically approved for fire pump services. Engine shall be supplied with all necessary accessories: cooling water system mounted on the engine.
- .2 The diesel engine shall conform to the requirements of the National Fire Protection Association, Pamphlet 20 (NFPA-20) and shall be specifically approved for fire pump service. It shall operate at a rated speed not exceeding the above rpm and shall develop sufficient horsepower to drive the pump. It is the responsibility of the pump manufacturer to properly size the driver taking into account horsepower correction factors for altitude and temperature per the latest edition of NFPA-20.
- .3 The following engine accessories shall be included:
 - Stub shaft
 - Air cleaner
 - Exhaust manifold
 - Heat exchanger
 - Mechanical speed governor
 - Fuel filter
 - Lube oil filter and bypass valve
 - Lube oil cooler and relief valve
 - Fuel pump
 - Instrument panel all mounted and complete with tachometer-hour meter, oil pressure gauge, water temperature gauge and ammeter
 - Starting system of suitable voltage including generator/alternator, starting motor and voltage regulator
 - Exhaust silencer, residential type
 - Flexible exhaust tubing
- .4 The diesel engine shall be arranged for automatic operation and include over-speed/over-crank switch and drive, two contractor switches, low oil and high water warning switches and fuel shut-off solenoid, with all wiring terminating in a junction box suitable for field hookup to the automatic engine control panel.
- .5 The diesel engine shall be fully assembled and factory tested by the engine manufacturer prior to shipment.

2.7 GEAR DRIVER:

- .1 The pump and engine shall be connected with a suitable flexible drive shaft and right angle gear drive. The gear drive shall be Factory Mutual (FM) approved vertical hollow shaft type with non-reverse ratchet. The nameplate horsepower rating of the gear drive must exceed the maximum horsepower required by the pump at any point on the pump curve. The gear ratio must be properly selected to match the engine input speed to the pump output speed. The mechanical losses in the gear drive must be taken into account when sizing the diesel engine.

2.8 PRESSURE MAINTENANCE (JOCKEY) PUMP

- .1 Multistage stainless steel submersible pump with 6m power cable.
- .2 Performance: refer to drawing schedule.

- .3 Complete with controller to monitor pump motor temperature, oil leakage, casing leaks, motor overload. Controller to be complete with dry contact for pressure switch input, and relays for alarm circuit to BAS. Controller to be inside epoxy powder-painted cabinet with hinged access door, and hand-off-auto switch and jeweled LEDs indicating status on door.

2.9 CONTROL PANELS

.1 MAIN CONTROL PANEL

- .1 The fire pump controller shall be specifically approved for fire pump service by the Underwriters Laboratories Association.
- .2 All equipment shall be enclosed in approved drip tight enclosure.
- .3 Controller shall function to automatically start the fire pump from the water pressure control switch in the controller. In order to insure that the engine will start in an emergency, the TEST switch (or TEST position of the controller switch) shall start the engine reducing the water pressure to the water pressure control switch in the controller.
- .4 Normal stopping of the engine shall be manually initiated by operating a stop push-button on the outside of the controller enclosure.
- .5 Under automatic conditions, the controller shall cause the starting current to be furnished by first one battery and then the other, i.e. it alternates automatically on each cranking cycle. Each cycle to consist of a 15 second cranking attempt followed by a 15 second test period and if the engine has not started after six attempts, the trouble alarms must operate. Crank, rest, and cranking time periods must be fixed and tamper proof. Field adjustments shall not be allowed.
- .6 The controller shall include a dual built-in battery charger that has been specifically approved for fire pump service. This charger, when operating at its rated voltage, shall be capable of fully recharging both batteries (after being completely discharged) within a 24 hour period. The chargers shall have automatic overload protection (current limiting) so that it will not be damaged by the low battery voltage while the engine is cranking. The control and rectifier circuits in the charger shall be completely redundant so that failure of any control component shall only effect the charging of the battery with which it is associated. Charging of the other battery shall not be effected under these circumstances. Individual voltmeters and ammeters shall be provided for each battery.
- .7 The controller shall also be furnished with a pressure recorder per the requirements of NFPA20.
- .8 The controller shall be fully assembled and factory tested by the controller manufacturer prior to shipment
- .9 PRESSURE SENSING - WETTED PARTS
 - .1 Shall be supplied with a pressure transducer (system) and run test solenoid valve assembly rated for 500psi working pressure (calibrated at 0-300psi) and be externally mounted with a protective cover
 - .2 Pressure sensing line connection to the pressure transducer shall be 1/2" FNPT
 - .3 Provision for a redundant pressure transducer shall be provided
- .10 SERVICE/FLOW TESTING CAPABILITIES
 - .1 Shall have the capability of scheduling maintenance reminders
 - .2 Shall also have the capability of inputting pump flow test data, generate and display the pump curve and store this information in memory for the lifetime of the controller.

- .11 CONNECTION FOR EXTERNAL DEVICES
 - .1 Manual remote start device
 - .2 Automatic remote start device
 - .3 Deluge valve start
- .12 DPDT DRY CONTACTS FOR REMOTE INDICATION (8A – 250VAC):
 - .1 Engine run
 - .2 Main switch in HAND or OFF
 - .3 Common controller trouble (fail safe)
 - .4 Common engine trouble (field re-assignable)
 - .5 Common pump room alarm (field re-assignable)
 - .6 Field programmable
- .13 AUDIBLE ALARM
 - .1 4” alarm bell rated for 85dB at 10ft (3m)
- .2 JOCKEY CONTROL PANEL
 - .1 APPROVALS
 - .1 CSA and UL508A
 - .2 SEISMIC CERTIFICATION
 - Test Criteria
 - .1 ICC-ES AC156
 - .1 Building Code
 - .1 IBC 2015
 - .2 CBC 2016 OSHPD Special Seismic Certification Preapproval – OSP
 - .3 Seismic Parameters: ASCE 7-10 Chapter 13
- .3 OPERATIONAL COMPONENTS AND STARTING METHOD
 - .1 Combined manual and automatic
 - .2 Horsepower rated disconnect switch
 - .3 Full voltage across the line starting
 - .4 Thermo-magnetic motor protector and a motor contactor
 - .5 Transformer with 24V.AC secondary
- .4 ENCLOSURE
 - .1 NEMA Type 2
- .5 OPERATOR INTERFACE
 - .1 Touch-pad type pushbuttons and a high luminosity LED digital display.
 - .2 Shall monitor and display motor operating conditions and pressure conditions
 - .3 Operational without opening the controller door.
- .6 VISUAL INDICATIONS
 - .1 The operator interface shall indicate:
 - .2 Manual motor run LED
 - .3 Automatic motor run LED

- .4 Motor overload
- .5 System pressure
- .6 Start pressure
- .7 Stop pressure
- .8 System pressure above stop pressure LED
- .9 System pressure in between start and stop pressure LED
- .10 System pressure below start pressure LED
- .11 Controller in AUTO mode
- .12 Controller in OFF mode
- .13 Pump start counter
- .14 Elapsed time meter (hours / non-resettable)
- .7 TIMERS
 - .1 Minimum run period timer
 - .2 Sequential start timer.
- .8 SOLID STATE PRESSURE TRANSDUCER
 - .1 Stainless steel
 - .2 Operational between 0 and 600psi
 - .3 External connection

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 ULC listing, [NFPA 20](#), manufacturer's instructions and reviewed shop drawings.
- .2 Install engine cooling system.
- .3 Insulate exhaust system, cooling system muffler in accordance with Section 23 07 19 - HVAC Piping Insulation.
- .4 Align pump and motor shafts to within manufacturer's recommended clearances prior to start-up.
- .5 Install wiring in accordance with manufacturer's instructions and applicable codes.

3.3 FIELD QUALITY CONTROL

- .1 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.
- .2 Site Tests:
 - .1 Field test each fire pump, driver and controllers in accordance with [NFPA 20](#). Testing to include:
 - .1 Verification of proper installation, system initiation, adjustment and fine tuning.
 - .2 Verification of the sequence of operations and alarm systems.
 - .2 Testing to be witnessed by authority having jurisdiction.
 - .3 Develop, with DCC Representative assistance, detailed instructions for O & M installation.
 - .4 Each fire pump shall be given a non-witnessed performance test and non-witnessed hydrostatic test of the discharge head and bowl assembly to NFPA-20 specifications at the factory before shipment. Minimum hydrostatic test pressure shall be twice shut-off pressure but not less than 250 psi.

3.4 CLEANING

- .1 Clean in accordance with Section 01 74 11 - Cleaning.
- .2 Clean installed products in accordance with manufacturer's recommendation.
- .3 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 19 Waste Management and Disposal.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 09 91 23 - Interior Painting.
- .2 Section 23 05 93 - Testing, Adjusting and Balancing for HVAC.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Shop Drawings:
 - .1 Submit drawings stamped and signed by professional engineer registered or licensed in Province of Ontario, Canada.
 - .2 Indicate on drawings:
 - .1 Mounting arrangements.
 - .2 Operating and maintenance clearances.
 - .3 Shop drawings and product data accompanied by:
 - .1 Detailed drawings of supports, and anchor bolts.
 - .2 Manufacturer to certify current model production.
 - .3 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.

1.3 CLOSEOUT SUBMITTALS

- .1 Submit in accordance with Section 01 78 00 - Closeout Submittals.
- .2 Operation and Maintenance Data: submit operation and maintenance data for incorporation into manual.
 - .1 Operation and maintenance manual approved by, and final copies deposited with, DCC Representative before final inspection.
 - .2 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.
 - .3 Performance data to include:
 - .1 Equipment manufacturer's performance datasheets with point of operation as left after commissioning is complete.
 - .2 Equipment performance verification test results.

- .3 Special performance data as specified.
- .4 Testing, adjusting and balancing reports as specified in Section 23 05 93 - Testing, Adjusting and Balancing for HVAC.
- .4 Approvals:
 - .1 Submit one (1) electronic copy of draft Operation and Maintenance Manual to DCC Representative for approval. Submission of individual data will not be accepted unless directed by DCC Representative.
 - .2 Make changes as required and re-submit as directed by DCC Representative.
- .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 Provide sets of white prints as required for each phase of work. Mark changes as work progresses and as changes occur. Include changes to existing mechanical systems, control systems and low voltage control wiring.
 - .2 Transfer information weekly to reproducibles, revising reproducibles to show work as actually installed.
 - .3 Use different colour waterproof ink for each service.
 - .4 Make available for reference purposes and inspection.
- .7 As-built drawings:
 - .1 Prior to start of Testing, Adjusting and Balancing for HVAC, finalize production of as-built drawings.
 - .2 Identify each drawing in lower right hand corner in letters at least 12 mm high as follows: - "AS BUILT DRAWINGS: THIS DRAWING HAS BEEN REVISED TO SHOW MECHANICAL SYSTEMS AS INSTALLED" (Signature of Contractor) (Date).
 - .3 Submit to DCC 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.

1.4 MAINTENANCE MATERIAL SUBMITTALS

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

1.5 DELIVERY, STORAGE AND HANDLING

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

- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store materials off ground, indoors, in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.
- .4 Packaging Waste Management: remove for reuse and return by manufacturer of pallets, crates, padding, and packaging materials in accordance with Section 01 74 19 - Waste Management and Disposal.

Part 2 Products

2.1 MATERIALS

- .1 All materials used on this project shall be new and CSA approved.

Part 3 Execution

3.1 EXAMINATION

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

3.2 PAINTING REPAIRS AND RESTORATION

- .1 Do painting in accordance with Section 09 91 23 - Interior Painting.
- .2 Prime and touch up marred finished paintwork to match original.
- .3 Restore to new condition, finishes which have been damaged.

3.3 SYSTEM CLEANING

- .1 Clean interior and exterior of all systems including strainers.

3.4 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 -ACTION AND INFORMATIONAL SUBMITTALS.

- .1 Perform tests as specified in other sections of this specification.

3.5 DEMONSTRATION

- .1 DCC 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 appropriate sections.
- .5 DCC Representative will record these demonstrations on video tape for future reference.

3.6 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.
 - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.
- .3 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 19 - Waste Management and Disposal.
 - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

3.7 PROTECTION

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

END OF SECTION

Part 1 General

1.1 REFERENCE STANDARDS

- .1 ASTM International (ASTM)
 - .1 [ASTM A 126-04\(R2019\)](#), Standard Specification for Gray Iron Castings for Valves, Flanges and Pipe Fittings.
 - .2 [ASTM B 62-2017](#), Standard Specification for Composition Bronze or Ounce Metal Castings.
- .2 American Water Works Association (AWWA)
 - .1 ANSI/AWWA C700-2020, Standard for Cold Water Meters-Displacement Type, Bronze Main Case.
 - .2 ANSI/AWWA C701-2019, Standard for Cold Water Meters-Turbine Type for Customer Service.
 - .3 ANSI/AWWA C702-2018, Standard for Cold Water Meters-Compound Type.
- .3 CSA Group (CSA)
 - .1 [CSA-B64](#) Series-2021, Backflow Preventers and Vacuum Breakers.
 - .2 [CSA B79-08\(R2018\)](#), Commercial and Residential Drains and Cleanouts.
 - .3 [CAN/CSA-B356-2010\(R2020\)](#), Water Pressure Reducing Valves for Domestic Water Supply Systems.
- .4 Efficiency Valuation Organization (EVO)
 - .1 International Performance Measurement and Verification Protocol (IPMVP).
 - .1 IPMVP 2007 Version.
- .5 National Research Council Canada (NRC)
 - .1 National Plumbing Code of Canada 2015 (NPC).
- .6 Plumbing and Drainage Institute (PDI)
 - .1 PDI-G101-R2017, Testing and Rating Procedure for Grease Interceptors with Appendix of Installation and Maintenance.
 - .2 PDI-WH201-R2017, Water Hammer Arresters Standard.

1.2 ADMINISTRATIVE REQUIREMENTS

- .1 Pre-installation Meetings:
 - .1 Convene pre-installation meeting 1 week prior to beginning work of this Section and on-site installation, with contractor's representative and DCC Representative to:
 - .1 Verify project requirements.
 - .2 Review installation and substrate conditions.
 - .3 Co-ordination with other building construction subtrades.
 - .4 Review manufacturer's written installation instructions and warranty requirements.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for plumbing products and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Shop Drawings:
 - .1 Indicate on drawings to indicate materials, finishes, method of anchorage, number of anchors, dimensions, construction and assembly details and accessories
- .4 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
- .5 Instructions: submit manufacturer's installation instructions.
- .6 Manufacturers' Field Reports: manufacturers' field reports specified.

1.4 CLOSEOUT SUBMITTALS

- .1 Submit in accordance with Section 01 78 00 - Closeout Submittals.
- .2 Operation and Maintenance Data: submit operation and maintenance data for plumbing specialties and accessories for incorporation into manual.
 - .1 Description of plumbing specialties and accessories, giving manufacturers name, type, model, year and capacity.
 - .2 Details of operation, servicing and maintenance.
 - .3 Recommended spare parts list.

1.5 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store materials in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect plumbing materials from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.
- .4 Develop Construction Waste Management Plan.
- .5 Packaging Waste Management: remove for reuse and return by manufacturer of pallets, crates, padding, and packaging materials as specified in Construction Waste Management Plan Waste Reduction Workplan in accordance with Section 01 74 19 Waste Management and Disposal.

Part 2 Products

2.1 FLOOR DRAINS

- .1 Floor Drains and Trench Drains: to [CSA B79](#).
- .2 Type FD: heavy duty; cast iron body, heavy duty non-tilting or hinged lacquered cast iron grate, integral seepage pan and clamping collar.

2.2 TRENCH DRAINS

- .1 Pre-Sloped Polypropylene Trench Drain System with Ductile Iron Frame. System to include frame connectors, grate lockdowns, and construction covers. Installation to be performed in accordance with manufacturer's installation instructions. Reinforced stainless steel slotted grate for truck traffic. Trench drain to be 300mm wide. Length to match existing.

2.3 CLEANOUTS

- .1 Cleanout Plugs: heavy cast iron male ferrule with brass screws and threaded brass or bronze plug. Sealing-caulked lead seat or neoprene gasket.
- .2 Access Covers:
 - .1 Wall Access: face or wall type, polished nickel bronze round cover with flush head securing screws, bevelled edge frame complete with anchoring lugs.
 - .2 Floor Access: round cast iron body and frame with adjustable secured nickel bronze top or cast box with anchor lugs and:
 - .1 Plugs: bolted bronze with neoprene gasket.
 - .2 Cover for Unfinished Concrete Floors: nickel bronze round, gasket, vandal-proof screws.

2.4 WATER HAMMER ARRESTORS

- .1 Copper construction, bellows type: to PDI-WH201.

2.5 BACK FLOW PREVENTERS

- .1 Preventers: to [CSA-B64](#) Series, application as indicated, double check valve assembly back flow preventer with intermediate atmospheric vent or vacuum breaker.

2.6 VACUUM BREAKERS

- .1 Breakers: to [CSA-B64](#) Series, vacuum breaker .

2.7 STRAINERS

- .1 860 kPa, Y type with 20 mesh, monel, bronze or stainless steel removable screen.
- .2 NPS 2 and under, bronze body, screwed ends, with brass cap.
- .3 NPS 2 1/2 and over, cast iron body, flanged ends, with bolted cap.

2.8 STORAGE TANK MIXER

- .1 Horizontal jet mixer for circulation in shallow tanks. Jet impeller for inducing a vortex plume.
- .2 Stainless steel construction.
- .3 345 watts, 120V.
- .4 5 year warranty.
- .5 NSF61 Certified.

2.9 EXPANSION TANKS

- .1 Construction
 - .1 Shell: ASME Approved Steel
 - .2 Diaphragm/Bladder: High-Performance Rubber Compound
 - .3 Liner Material: Polypropylene
 - .4 System Connection: Stainless Steel
 - .5 Finish: Fire Protection Red
 - .6 Air Valve: Schrader Valve w/ EPDM Seats
 - .7 Factory Pre-Charge: 25 PSIG (1.7 bar)
- .2 Performance
 - .1 Min./Max. Operating Temperature: -20° F (-29° C) to 200° F (93° C)
 - .2 Max. Working Pressure: 175 PSIG (12 bar)
 - .3 Warranty: 3-Year Limited

2.10 TRAP SEAL PRIMER

- .1 Electronic trap seal primer with electronic timer to distribute 2 ounces of water per 24 hour period. Complete with test button, stainless steel slow closing solenoid valve, low-lead brass isolation valve, 16 gauge powder epoxy coated steel cabinet, 5 outlet ports, lead-free vacuum breaker, 120V power supply adapter.

2.11 FLOW METER

- .1 Provide an insertion electromagnetic flowmeter complete with NIST traceable, wet calibrated flow-measuring element, remote transmitter, installation valves, adjustable installation depth gage and calibration certificate. Flowmeter shall be wet tappable, allowing insertion and removal from the flow stream without system shutdown.
- .2 Wetted components shall be constructed of 316L stainless steel with an attached tag indicating calibration information. Sensor technology shall have a NEMA6 enclosure and NEMA4 local display.
 - .1 Maximum Pressure Rating: 400 psig
 - .2 Fluid Temperature Rating: 15F to 250F
 - .3 Ambient Conditions Transmitter: -20F to 150F
 - .4 Pipe Size Range Available Options

- .5 Standard Configuration: 3 - 72" nominal diameter
 - .6 Small Pipe Configuration: 1 1/4 - 2 1/2" nominal diameter
 - .7 End Connections for NPS 1.25" and Larger: 1" Male NPT Hot Tap Adapter fitting. Installation through 1" full port isolation valve, minimum.
- .3 Accuracy: Flowmeter shall provide calibrated outputs directly from the integral transmitter, throughout the operating range with the accuracy stated as follows:
- i. Accuracy:
 - a. Standard Sensor (3"-72") $\pm 1.0\%$ of reading from 2 - 20 ft/s | ± 0.02 ft/s below 2 ft/s
 - b. Small Pipe Sensor (1.25" – 2.5") $\pm 1.0\%$ of reading from 1.6 - 16 ft/s | ± 0.016 ft/s below 1.6 ft/s
 - ii. Flow Range:
 - a. Standard Sensor (3"-72"): 0.1 ft/s to 20 ft/s (200:1 turndown)
 - b. Small Pipe Sensor (1.25"-2.5"): 0.08 ft/s to 16 ft/s (200:1 turndown)
 - iii. Minimum Conductivity: 25 $\mu\text{S/cm}$
- .4 Local Display: Local display shall provide instantaneous flow rate information and totalized flow information and shall be factory configured to a specific configuration given by the contractor.
- .1 Input Power: 22-26VDC with maximum power draw at 25 Watts. 20-28VAC with maximum power draw at 30VA, 60 Hz.
 - .2 I/O Signals: Transmitter should provide.
 - .3 Two (2) Analog Output: Active 4-20mA, 0-10V, or 0-5V.
 - .4 Two (2) Analog Inputs: Passive 4-20mA.
 - .5 Two (2) 1000ohms RTD Inputs.
 - .6 Three (3) Digital Inputs/Output. (Field Selectable)
 - .7 One (1) Frequency Output (0-15V peak pulse, 0-1000hz)
 - .8 Mounting Option: Remote mount with kit, up to 200ft.
 - .9 Display Size: 4.3-inch touch screen display with a resolution of 480 x 272 pixels
 - .10 Programming Available Options: Password-protected menu-driven user interface via touchscreen.
 - .11
- .5 Electrical Connections:
- .1 Input Power: Removable orange terminal blocks for use with 12-20 AWG
 - .2 I/O Signals: Removable green terminal blocks for use with 14-30 AWG
 - .3 Coil & Electrodes: Removable green terminal blocks for use with 14-24 AWG
 - .4 RS485: Removable green terminal blocks for use with 14-30 AWG
 - .5 IP: RJ45 connector

Part 3 Execution

3.1 EXAMINATION

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

3.2 MANUFACTURER'S INSTRUCTIONS

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

3.3 INSTALLATION

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

3.4 CLEANOUTS

- .1 Install cleanouts at base of soil and waste stacks, and rainwater leaders, at locations required code, and as indicated.
- .2 Bring cleanouts to wall or finished floor unless serviceable from below floor.
- .3 Building drain cleanout and stack base cleanouts: line size to maximum NPS 4.

3.5 WATER HAMMER ARRESTORS

- .1 Install on branch supplies to fixtures or group of fixtures where indicated.

3.6 BACK FLOW PREVENTERS

- .1 Install in accordance with [CSA-B64](#) Series, where indicated and elsewhere as required by code.
- .2 Pipe discharge to terminate over nearest drain or service sink.

3.7 TRAP SEAL PRIMERS

- .1 Install for floor drains and elsewhere, as indicated.
- .2 Install on cold water supply to nearest frequently used plumbing fixture, in concealed space, to approval of DCC Representative.
- .3 Install soft copper or plastic tubing to floor drain.

3.8 STRAINERS

- .1 Install with sufficient room to remove basket for maintenance.

3.9 START-UP

- .1 General:
 - .1 In accordance with Section 01 91 13 - General Commissioning Requirements: General Requirements, supplemented as specified herein.
- .2 Timing: start-up only after:
 - .1 Pressure tests have been completed.
 - .2 Disinfection procedures have been completed.
 - .3 Certificate of static completion has been issued.
 - .4 Water treatment systems operational.
- .3 Provide continuous supervision during start-up.

3.10 TESTING AND ADJUSTING

- .1 General:
 - .1 Test and adjust plumbing specialties and accessories in accordance with Section 01 91 13 - General Commissioning Requirements: General Requirements, supplemented as specified.
- .2 Timing:
 - .1 After start-up deficiencies rectified.
 - .2 After certificate of completion has been issued by authority having jurisdiction.
- .3 Application tolerances:
 - .1 Pressure at fixtures: +/- 70 kPa.
 - .2 Flow rate at fixtures: +/- 20%.
- .4 Adjustments:
 - .1 Verify that flow rate and pressure meet design criteria.
 - .2 Make adjustments while flow rate or withdrawal is (1) maximum and (2) 25% of maximum and while pressure is (1) maximum and (2) minimum.
- .5 Floor drains:
 - .1 Verify operation of trap seal primer.
 - .2 Prime, using trap primer. Adjust flow rate to suit site conditions.
 - .3 Check operations of flushing features.
 - .4 Check security, accessibility, removability of strainer.
 - .5 Clean out baskets.
- .6 Vacuum breakers, backflow preventers, backwater valves:
 - .1 Test tightness, accessibility for O&M of cover and of valve.

- .2 Simulate reverse flow and back-pressure conditions to test operation of vacuum breakers, backflow preventers.
- .3 Verify visibility of discharge from open ports.
- .7 Access doors:
 - .1 Verify size and location relative to items to be accessed.
- .8 Cleanouts:
 - .1 Verify covers are gas-tight, secure, yet readily removable.
- .9 Water hammer arrestors:
 - .1 Verify proper installation of correct type of water hammer arrester.
- .10 Pressure regulators, PRV assemblies:
 - .1 Adjust settings to suit locations, flow rates, pressure conditions.
- .11 Strainers:
 - .1 Clean out repeatedly until clear.
 - .2 Verify accessibility of cleanout plug and basket.
 - .3 Verify that cleanout plug does not leak.

3.11 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.
 - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.
- .3 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 19 Waste Management and Disposal.
 - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

3.12 PROTECTION

- .1 Protect installed products and components from damage during construction.
- .2 Repair damage to adjacent materials caused by plumbing specialties and accessories installation.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 23 05 15 Common Installation Requirements for HVAC Pipework.

1.2 REFERENCE STANDARDS

- .1 American Society of Mechanical Engineers International (ASME)
 - .1 [ANSI/ASME B16.15-2018](#), Cast Copper Alloy Threaded Fittings, Classes 125 and 250.
 - .2 [ANSI/ASME B16.18-2018](#), Cast Copper Alloy Solder Joint Pressure Fittings.
 - .3 [ANSI/ASME B16.22-2018](#), Wrought Copper and Copper Alloy Solder Joint Pressure Fittings.
 - .4 [ANSI/ASME B16.24-2016](#), Cast Copper Alloy Pipe Flanges and Flanged Fittings: Class 150, 300, 400, 600, 900, 1500 and 2500.
 - .5 [ASME B16.26-2018](#), Cast Copper Alloy Fittings for Flared Copper Tubes.
 - .6 [ASME B31.9-2020](#), Building Services Piping.
 - .7 [ASME B36.19M-2018](#), Stainless Steel Pipe.
- .2 ASTM International (ASTM)
 - .1 [ASTM A 182/A 182M-2021](#), Standard Specification for Forged or Rolled Alloy and Stainless Steel Pipe Flanges, Forged Fittings, and Valves and Parts for High-Temperature Service.
 - .2 [ASTM A 269-15a\(r2019\)](#), Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service.
 - .3 [ASTM A 307-2021](#), Standard Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.
 - .4 [ASTM A 312/A 312M-2021](#), Seamless, Welded, and Heavily Cold Worked Austenitic Stainless Steel Pipes.
 - .5 [ASTM A 351/A 351M-18e1](#), Castings, Austenitic, for Pressure Containing Parts.
 - .6 [ASTM A 403/A 403M-2020](#), Wrought Austenitic Stainless Steel Piping Fittings.
 - .7 [ASTM A 536-84\(r2019e1\)](#), Standard Specification for Ductile Iron Castings.
 - .8 [ASTM B 32-2020](#), Standard Specification for Solder Metal.
 - .9 [ASTM B 42-2020](#), Seamless Copper Tube, Standard Sizes.
 - .10 [ASTM B 88M-2020](#), Standard Specification for Seamless Copper Water Tube (Metric).
 - .11 [ASTM F 876-2020b](#), Standard Specification for Crosslinked Polyethylene (PEX) Tubing.
 - .12 [ASTM F 877-2020](#), Standard Specification for Crosslinked Polyethylene (PEX) Hot and Cold Water Distribution System.
- .3 American National Standards Institute/American Water Works Association (ANSI)/(AWWA)
 - .1 [ANSI/AWWA C111/A21.11-2017](#), Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.
 - .2 [ANSI/AWWA C151/A21.51-2017](#), Ductile Iron Pipe, Centrifugally Cast, for Water.

- .3 [AWWA C904-2016](#), Crosslinked Polyethylene (PEX) Pressure Pipe, ½ In. (12 mm) through 3 In. (76mm), for Water Service.
- .4 CSA Group (CSA)
 - .1 [CSA B137.5-20](#), Crosslinked Polyethylene (PEX) Tubing Systems for Pressure Applications.
 - .2 [CSA B242-2005\(R2021\)](#), Groove and Shoulder Type Mechanical Pipe Couplings.
- .5 Underwriters Laboratories of Canada (ULC)
 - .1 CAN/ULC S101-2014, Fire Endurance Tests of Buildings Construction and Materials.
 - .2 CAN/ULC S102.2-2018, Method of Test for Surface Burning Characteristics of Flooring, Floor Coverings and Miscellaneous Materials and Assemblies.
 - .3 CAN/ULC S115-2018, Standard Method of Fire Tests of Firestop.
- .6 Department of Justice Canada (Jus)
 - .1 Canadian Environmental Protection Act, 1999, c. 33 (CEPA).
- .7 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
 - .1 Safety Data Sheets (SDS).
- .8 Manufacturer's Standardization Society of the Valve and Fittings Industry (MSS).
 - .1 MSS-SP-67-2017, Butterfly Valves.
 - .2 MSS-SP-70-2011, Grey Iron Gate Valves, Flanged and Threaded Ends.
 - .3 MSS-SP-71-2018, Grey Iron Swing Check Valves, Flanged and Threaded Ends.
 - .4 MSS-SP-80-2019, Bronze Gate, Globe, Angle and Check Valves.
- .9 National Research Council (NRC)
 - .1 National Plumbing Code of Canada (NPC) 2015.
- .10 Transport Canada (TC)
 - .1 Transportation of Dangerous Goods Act, 1992, c. 34 (TDGA).

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 DELIVERY, STORAGE AND HANDLING

- .1 Packaging Waste Management: remove for reuse and return by manufacturer of pallets, crates, padding and packaging materials in accordance with Section 01 74 19 Waste Management and Disposal.
- .2 Place materials defined as hazardous or toxic in designated containers.
- .3 Handle and dispose of hazardous materials in accordance with CEPA, TDGA, Regional and Municipal regulations.

Part 2 Products

2.1 PIPING

- .1 Domestic hot, cold and recirculation systems, within building.
 - .1 Above ground:
 - .1 Copper tube, hard drawn, type L: to [ASTM B 88M](#).
 - .2 Buried or embedded:
 - .1 Copper tube, soft annealed, type K: to [ASTM B 88M](#), in long lengths and with no buried joints.

2.2 FITTINGS

- .1 Bronze pipe flanges and flanged fittings, Class 150: to ANSI/ASME B16.24.
- .2 Cast bronze threaded fittings, Class 125: to ANSI/ASME B16.15.
- .3 Cast copper, solder type: to ANSI/ASME B16.18.
- .4 Wrought copper and copper alloy, solder type: to ANSI/ASME B16.22.
- .5 NPS 2 and larger:
 - .1 ANSI/ASME B16.18 or ANSI/ASME B16.22 roll grooved to [CSA B242](#).
- .6 NPS 1 ½ and smaller:
 - .1 cast copper to ANSI/ASME B16.18; with 301 stainless steel internal components and EPDM seals. Suitable for operating pressure to 1380 kPa.

2.3 JOINTS

- .1 Rubber gaskets, latex-free 1.6 mm thick: to AWWA C111.
- .2 Bolts, nuts, hex head and washers: to [ASTM A 307](#), heavy series.
- .3 Solder: 95/5 tin copper alloy.
- .4 Teflon tape: for threaded joints.

- .5 Grooved couplings: designed with angle bolt pads to provide rigid joint, complete with EPDM gasket.
- .6 Dielectric connections between dissimilar metals: dielectric fitting, complete with thermoplastic liner.

2.4 GATE VALVES

- .1 NPS 2 and under, soldered:
 - .1 Rising stem: to MSS-SP-80, Class 125, 860 kPa, bronze body, screw-in bonnet, solid wedge disc as specified Section 23 05 23.01 - Valves - Bronze.
- .2 NPS 2 and under, screwed:
 - .1 Rising stem: to MSS-SP-80, Class 125, 860 kPa, bronze body, screw-in bonnet, solid wedge disc as specified Section 23 05 23.01 - Valves - Bronze.
- .3 NPS 2 1/2 and over, in mechanical rooms, flanged:
 - .1 Rising stem: to MSS-SP-70, Class 125, 860 kPa, flat flange faces, cast-iron body, OS&Y bronze trim specified Section 23 05 23.02 - Valves - Cast Iron.

2.5 SWING CHECK VALVES

- .1 NPS 2 and under, soldered:
 - .1 To MSS-SP-80, Class 125, 860 kPa, bronze body, bronze swing disc, screw in cap, regrindable seat as specified Section 23 05 23.01 - Valves - Bronze.
- .2 NPS 2 and under, screwed:
 - .1 To MSS-SP-80, Class 125, 860 kPa, bronze body, bronze swing disc, screw in cap, regrindable seat as specified Section 23 05 23.01 - Valves - Bronze.
- .3 NPS 2 1/2 and over, flanged:
 - .1 To MSS-SP-71, Class 125, 860 kPa, cast iron body, flat flange faces, renewable seat, bronze disc, bolted cap specified Section 23 05 23.02 - Valves - Cast Iron: Gate, Globe, Check.

2.6 BALL VALVES

- .1 NPS 2 and under, screwed:
 - .1 Class 150.
 - .2 Bronze body, stainless steel ball, PTFE adjustable packing, brass gland and PTFE seat, steel lever handle as specified Section 23 05 23.01 - Valves - Bronze.
- .2 NPS 2 and under, soldered:
 - .1 To ANSI/ASME B16.18, Class 150.
 - .2 Bronze body, stainless steel ball, PTFE adjustable packing, brass gland and PTFE seat, steel lever handle, with NPT to copper adaptors as specified Section 23 05 23.01 - Valves - Bronze.
- .3 NPS 2 and under, mechanical:

- .1 To [CSA B137.5](#) and [ASTM F 1960](#).
- .2 Lead free brass body.

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 Plumbing Code and local authority having jurisdiction.
- .2 Install pipe work in accordance with Section 23 05 15 - Common Installation Requirements for HVAC Pipework, supplemented as specified herein.
- .3 Assemble piping using fittings manufactured to ANSI and Standard Council of Canada (SCC) standards.
- .4 Install CWS piping below and away from HWS and HWC and other hot piping so as to maintain temperature of cold water as low as possible.
- .5 Connect to fixtures and equipment in accordance with manufacturer's written instructions unless otherwise indicated.
- .6 Buried tubing:
 - .1 Lay in well compacted washed sand in accordance with AWWA Class B bedding.
 - .2 Bend tubing without crimping or constriction. Minimize use of fittings.
- .7 Valves
 - .1 Isolate equipment, fixtures and branches with gate valves.

3.3 PRESSURE TESTS

- .1 Test pressure: greater of 1 times maximum system operating pressure or 860 kPa.

3.4 FLUSHING AND CLEANING

- .1 Flush entire system for 8 h. Ensure outlets flushed for 2 hours. Let stand for 24 hours, then draw one sample off longest run. Submit to testing laboratory to verify that system is clean copper to Federal potable water guidelines. Let system flush for additional 2 hours, then draw off another sample for testing.

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 Ensure that pressure booster systems are operating properly.

- .4 Ensure that air chambers, expansion compensators are installed properly.

3.6 DISINFECTION

- .1 Flush out, disinfect and rinse system to requirements of authority having jurisdiction and approval of DCC Representative.
- .2 Coordinate with Section 33 14 16 – Site Water Utility Distribution Piping.
- .3 Upon completion, provide laboratory test reports on water quality for DCC Representative approval.

3.7 START-UP

- .1 Timing: start up after:
 - .1 Pressure tests have been completed.
 - .2 Disinfection procedures have been completed.
 - .3 Certificate of static completion has been issued.
 - .4 Water treatment systems operational.
- .2 Provide continuous supervision during start-up.
- .3 Start-up procedures:
 - .1 Establish circulation and ensure that air is eliminated.
 - .2 Check pressurization to ensure proper operation and to prevent water hammer, flashing and/or cavitation.
 - .3 Monitor piping HWC piping systems for freedom of movement, pipe expansion as designed.
 - .4 Check control, limit, safety devices for normal and safe operation.
- .4 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 Criteria.
 - .2 Adjust pressure regulating valves while withdrawal is maximum and inlet pressure is minimum.
 - .3 Sterilize HWS and HWC systems for Legionella control.
 - .4 Verify performance of temperature controls.
 - .5 Verify compliance with safety and health requirements.

- .6 Check for proper operation of water hammer arrestors. Run one outlet for 10 seconds, then shut of water immediately. If water hammer occurs, replace water hammer arrestor or re-charge air chambers. Repeat for outlets and flush valves.
- .7 Confirm water quality consistent with supply standards, and ensure no residuals remain as result of flushing or cleaning.
- .3 Reports:
 - .1 In accordance with Section 01 91 13 - General Commissioning (Cx) Requirements
 - .2 Include certificate of water flow and pressure tests conducted on incoming water service, demonstrating adequacy of flow and pressure.

3.9 OPERATION REQUIREMENTS

- .1 Co-ordinate operation and maintenance requirements including cleaning and maintenance of specified materials and products with Section 23 05 15 - Common Installation Requirements for HVAC Pipework.

3.10 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 19 Waste Management and Disposal.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 23 05 15 - Common installation requirements for HVAC pipework

1.2 REFERENCE STANDARDS

- .1 ASTM International (ASTM)
 - .1 ASTM B 32-08, Standard Specification for Solder Metal.
 - .2 ASTM B 306-02, Standard Specification for Copper Drainage Tube (DWV).
 - .3 ASTM C 564-03a, Standard Specification for Rubber Gaskets for Cast Iron Soil Pipe and Fittings.
- .2 CSA Group (CSA)
 - .1 CSA B67-1972(R1996), Lead Service Pipe, Waste Pipe, Traps, Bends and Accessories.
 - .2 CAN/CSA-B70-06, Cast Iron Soil Pipe, Fittings and Means of Joining.
 - .3 CAN/CSA-B125.3-05, Plumbing Fittings.
- .3 Green Seal Environmental Standards (GSES)
 - .1 Standard GS-36-00, Commercial Adhesives.
- .4 National Research Council Canada (NRC)
 - .1 National Plumbing Code of Canada 20120 (NPC).
- .5 South Coast Air Quality Management District (SCAQMD), California State
 - .1 SCAQMD Rule 1168-A2005, Adhesive and Sealant Applications.

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 adhesives, and include product characteristics, performance criteria, physical size, finish and limitations.

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 Packaging Waste Management: remove for reuse and return by manufacturer of pallets, crates, padding and packaging materials in accordance with Section 01 74 19 - Waste Management and Disposal.

Part 2 Products

2.1 COPPER TUBE AND FITTINGS

- .1 Above ground sanitary, storm and vent Type DWV to: ASTM B 306
 - .1 Fittings.
 - .1 Cast brass: to CAN/CSA-B125.3
 - .2 Wrought copper: to CAN/CSA-B125.3
 - .2 Solder: tin-lead, 50:50, type 50A or lead free, tin-antimony, 95:5, type TA, to ASTM B 32

2.2 CAST IRON PIPING AND FITTINGS

- .1 Buried sanitary, storm and vent minimum NPS 3, to: CAN/CSA-B70, with one layer of protective coating of bituminous.
 - .1 Joints:
 - .1 Mechanical joints:
 - .1 Neoprene or butyl rubber compression gaskets: to CAN/CSA-B70 or ASTM C 564
 - .2 Stainless steel clamps.
 - .2 Hub and spigot:
 - .1 Caulking lead: to CSA B67
 - .2 Cold caulking compounds.
 - .2 Above ground sanitary, storm and vent: to CAN/CSA-B70
 - .1 Joints:
 - .1 Hub and spigot:
 - .1 Caulking lead: to CSA B67
 - .2 Mechanical joints:
 - .1 Neoprene or butyl rubber compression gaskets with stainless steel clamps.

2.3 PIPING EXPOSED IN RESERVOIR

- .1 Sanitary and vent piping beneath the pump house floor slab exposed inside the water reservoir to be 304 stainless steel, schedule 40
 - .1 Joints:
 - .1 Flanged or Push fit gasketed joints to avoid cutting or threading that reduce corrosion resistance.

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 In accordance with Section 23 05 15 - Common installation requirements for HVAC pipework.
- .2 Install in accordance with National Plumbing Code, Provincial Plumbing Code and local authority having jurisdiction.

3.3 TESTING

- .1 Pressure test buried systems before backfilling.
- .2 Hydraulically test to verify grades and freedom from obstructions.

3.4 PERFORMANCE VERIFICATION

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

3.5 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 19 - Waste Management and Disposal.

END OF SECTION

Part 1 General

1.1 USE OF SYSTEMS

- .1 Use of new or existing permanent heating and/or ventilating systems for supplying temporary heat or ventilation is not permitted.

Part 2 Products

2.1 NOT USED

- .1 Not Used.

Part 3 Execution

3.1 NOT USED

- .1 Not Used.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

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

1.2 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data: Submit manufacturer's instructions, product literature, and data sheets for products and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Shop Drawings:
 - .1 Indicate on drawings:
 - .1 Mounting arrangements.
 - .2 Operating and maintenance clearances.
 - .2 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.
 - .3 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.

1.3 CLOSEOUT SUBMITTALS

- .1 Submit in accordance with Section 01 78 00 - Closeout Submittals.
- .2 Operation and Maintenance Data: submit operation and maintenance data and incorporate into manual.
 - .1 Operation and maintenance manual approved by, and final copies submitted to DCC Representative before final inspection.
 - .2 Operation data to include:
 - .1 Control schematics for systems including environmental controls.
 - .2 Description of systems and their controls.
 - .3 Operation instruction for systems and component.
 - .4 Description of actions to be taken in event of equipment failure.
 - .5 Valves schedule and flow diagram.
 - .6 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 complete.
 - .2 Equipment performance verification test results.
 - .3 Special performance data as specified.
 - .4 Testing, adjusting and balancing reports as specified in Section 23 05 93 - Testing, Adjusting and Balancing for HVAC.
- .5 Approvals:
 - .1 Submit one (1) electronic copy of draft Operation and Maintenance Manual to DCC Representative for approval. Submission of individual data will not be accepted unless directed by DCC Representative.
 - .2 Make changes as required and re-submit as directed by DCC Representative.
- .6 Additional data:
 - .1 Prepare and insert into operation and maintenance manual additional data when need for it becomes apparent during specified demonstrations and instructions.
- .7 Site records:
 - .1 Provide sets of white prints as required for each phase of work. Mark changes as work progresses and as changes occur. Include changes to existing mechanical systems, control systems and low voltage control wiring.
 - .2 Transfer information weekly to reproducibles, revising reproducibles to show work as actually installed.
 - .3 Use different colour waterproof ink for each service.
 - .4 Make available for reference purposes and inspection.
- .8 As-built drawings:
 - .1 Prior to start of Testing, Adjusting and Balancing for HVAC, finalize production of as-built drawings.
 - .2 Identify each drawing in lower right hand corner in letters at least 12 mm high as follows: - "AS BUILT DRAWINGS: THIS DRAWING HAS BEEN REVISED TO SHOW MECHANICAL SYSTEMS AS INSTALLED" (Signature of Contractor) (Date).
 - .3 Submit to DCC 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.
- .9 Submit copies of as-built drawings for inclusion in final TAB report.

1.4 MAINTENANCE MATERIAL SUBMITTALS

- .1 Submit in accordance with Section 01 78 00 - Closeout Submittals.
- .2 Supply spare parts as follows:
 - .1 One set of packing for each pump.
 - .2 One casing joint gasket for each size pump.

- .3 One glass for each gauge glass.
- .4 One filter cartridge or set of filter media for each filter or filter bank in addition to final operating set.
- .3 Supply one set of special tools required to service equipment as recommended by manufacturers.
- .4 Supply one commercial quality grease gun, grease and adapters to suit different types of grease and grease fittings.

1.5 DELIVERY, STORAGE, AND HANDLING

- .1 Packaging Waste Management: Perform in accordance with Section 01 74 19 - Waste Management and Disposal.

Part 2 Products

2.1 MATERIALS

- .1 All materials used on this project shall be new and CSA approved.

Part 3 Execution

3.1 EXAMINATION

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

3.2 SITE 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 - ACTION AND INFORMATIONAL SUBMITTALS.
 - .1 Submit tests as specified in other sections of this specification.
- .2 Manufacturer's Site Services:
 - .1 Obtain written report from manufacturer verifying compliance of Work, in handling, installing, applying, protecting and cleaning of product and submit Manufacturer's Site Reports as described in PART 1 - ACTION AND INFORMATIONAL SUBMITTALS.
 - .2 Provide manufacturer's site services consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturer's instructions.

3.3 ADJUSTING

- .1 Prime and touch up marred finished paintwork to match original.

.2 Perform painting in accordance with Section 09 91 23 - Interior Painting.

.3 Restore finishes which have been damaged to a "like new" condition.

3.4 CLEANING

.1 Final Cleaning: Perform in accordance with Section 01 74 11 - Cleaning and clean interior and exterior of all systems including strainers. Vacuum interior of ductwork.

3.5 DEMONSTRATION

.1 DCC Representative will use equipment and systems for test purposes prior to acceptance. Supply labour, material, and instruments required for testing.

.2 Trial usage to apply to following equipment and systems:

.1 Exhaust fans.

.3 Supply tools, equipment and personnel to demonstrate and instruct operating and maintenance personnel in operating, controlling, adjusting, trouble-shooting and servicing of all systems and equipment during regular work hours, prior to acceptance.

.4 Use operation and maintenance manual, as-built drawings, and audio-visual aids as part of instruction materials.

.5 Instruction duration time requirements as specified in appropriate Sections.

.6 DCC Representative will record these demonstrations for future reference.

3.6 PROTECTION

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

END OF SECTION

Part 1 General

1.1 REFERENCE STANDARDS

- .1 American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE)/Illuminating Engineering Society (IES):
 - .1 ANSI/ASHRAE/IES 90.1-2022 - Energy Standard for Sites and Buildings Except Low-Rise Residential Buildings.
- .2 CSA Group (CSA):
 - .1 CSA C390:10, Test methods, marking requirements, and energy efficiency levels for three-phase induction motors.
- .3 National Electrical Manufacturers Association (NEMA):
 - .1 ANSI/NEMA MG 1-2021, Motors and Generators.
 - .2 NEMA MG 11-1977, Energy Management Guide for Selection and Use of Single-Phase Motors

1.2 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's product literature, specifications, and datasheets, including product characteristics, performance criteria, wiring characteristics, and limitations.
 - .2 Submit a complete list of HVAC motors and identify their locations before beginning installation of motors.
- .3 Shop Drawings: Submit drawings, stamped and signed by a professional engineer, indicating work of other Subcontractors, and identify areas that might have congestion or conflicts.
- .4 When requested, submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.

1.3 CLOSEOUT SUBMITTALS

- .1 Submit in accordance with Section 01 78 00 - Closeout Submittals.
- .2 Submit maintenance data for motors, drives, and guards and incorporate into operation and maintenance manual.

1.4 MAINTENANCE MATERIALS SUBMITTALS

- .1 Supply one set of spare belts for each set installed in accordance with Section 01 78 00 - Closeout Submittals, unless otherwise indicated in other Division 23 Sections.

1.5 QUALITY ASSURANCE

- .1 Where multiple motors are required for the same application, provide the same manufacturer's motor model for all identical conditions.
- .2 Health and Safety Requirements: Comply with Section 01 35 29.06 - Health and Safety Requirements.

1.6 DELIVERY, STORAGE, AND HANDLING

- .1 Packing, shipping, handling, and unloading: Perform in accordance with Section 01 61 00 - Common Product Requirements, and as follows:
 - .1 Protect motors from dust and corrosion.
- .2 Packaging Waste Management and Disposal: Perform Waste Management Plan in accordance with Section 01 74 19 - Waste Management and Disposal.

Part 2 Products

2.1 REGULATORY REQUIREMENTS

- .1 Motors shall be premium efficiency, in accordance with local hydro company standards and the requirements of ASHRAE 90.1.

2.2 MOTORS

- .1 Provide motors for mechanical equipment as specified in other Sections.
- .2 Motors under 373 W (1/2 hp): NEMA MG, speed, continuous duty, built-in overload protection, resilient mount, single phase, 120 V, unless otherwise specified or indicated on Drawings.
- .3 Motors 373 W (1/2 hp) and larger: ANSI/NEMA MG 1, CSA C390, squirrel cage induction, speed as indicated, continuous duty, drip-proof, ball bearing, maximum temperature rise 40°C, 3 phase, 575 V, unless otherwise indicated.
- .4 Temporary Motors: Motor with adequate performance approved by DCC Representative for temporary use.

2.3 BELT DRIVES

- .1 Fit reinforced belts in sheave matched to drive. Multiple belts to be matched sets.
- .2 Use cast iron or steel sheaves secured to shafts with removable keys unless otherwise indicated.
- .3 For motors under 7.5 kW (10 hp): Standard adjustable pitch drive sheaves, having plus or minus 10% range. Use mid-position of range for specified motor rpm.
- .4 For motors 7.5 kW (10 hp) and over: Sheave with split tapered bushing and keyway having fixed pitch unless specifically required for item concerned. Provide sheave of correct size to suit balancing.

- .5 Determine correct sheave size during commissioning.
- .6 Minimum drive rating: 1.5 times nameplate rating on motor. Keep overhung loads within manufacturer's design requirements on prime mover shafts.
- .7 Provide motor slide rail adjustment plates to allow for centre line adjustment.

2.4 DRIVE GUARDS

- .1 Provide guards for unprotected drives.
- .2 Guards for belt drives:
 - .1 Expanded metal screen welded to steel frame.
 - .2 Minimum 1.2mm thick sheet metal tops and bottoms.
 - .3 38mm diameter holes on both shaft centres for insertion of tachometer.
 - .4 Removable for servicing.
- .3 Drive Guards: Designed to allow motor maintenance (lubrication and use of test instruments) with guards in place.
- .4 Guard for flexible coupling:
 - .1 "U" shaped, minimum 1.6-mm-thick galvanized mild steel.
 - .2 Fasten securely in place.
 - .3 Removable for servicing.
- .5 Unprotected fan inlets or outlets:
 - .1 Wire or expanded metal screen, galvanized, 19mm mesh.
 - .2 Net free area of guard: not less than 80% of fan openings.
 - .3 Fasten securely in place.
 - .4 Removable for servicing.

Part 3 Execution

3.1 INSTALLATION

- .1 Install according to manufacturer's instructions and supplemented by the requirements of the Contract Documents.
- .2 Locate motors with adequate access space to allow safe and unimpeded maintenance services.
- .3 Install with minimum interference with other equipment and services.
- .4 Install belt guards to allow movement of motors for adjusting belt tension.
- .5 Fasten motors and equipment securely in place.
- .6 Replace temporary motors with specified motors.

3.2 SITE QUALITY CONTROL

- .1 Field Tests: Conduct the following tests in accordance with Section 01 45 00 - Quality Control.
 - .1 As specified in other sections of this specification.

3.3 CLEANING

- .1 Comply with Section 01 74 11 - Cleaning.
- .2 Remove surplus materials, rubbish, tools, and equipment.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 07 92 00 - Joint Sealants

1.2 REFERENCE STANDARDS

- .1 Canadian General Standards Board (CGSB):
 - .1 CAN/CGSB-1.181-99, Ready-Mixed Organic Zinc-Rich Coating.
- .2 CSA Group (CSA):
 - .1 CAN/CSA B139-19, Installation Code for Oil Burning Equipment.
- .3 Green Seal Environmental Standards (GS):
 - .1 Standard GS-11-2008, 2nd Edition, Environmental Standard for Paints and Coatings
- .4 National Research Council Canada (NRC):
 - .1 National Fire Code of Canada 2015 (NFC)
- .5 South Coast Air Quality Management District (SCAQMD), California State, Regulation XI:
 - .1 SCAQMD Rule 1113-2016, Architectural Coatings
 - .2 SCAQMD Rule 1168-2017, Adhesive and Sealant Applications

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 and equipment and include product characteristics, performance criteria, physical size, finish and limitations.

1.4 DELIVERY, STORAGE, AND HANDLING

- .1 Deliver, store, and handle materials in accordance with Section 01 61 00 - Common Product Requirements.
- .2 Packaging Waste Management: remove for reuse and return by manufacturer of pallets, crates, padding, and packaging materials in accordance with Section 01 74 19 - Waste Management and Disposal.

Part 2 Products

2.1 MATERIALS

- .1 Paint: zinc-rich to CAN/CGSB-1.181.

- .1 Primers, Paints, Coating: in accordance with manufacturer's recommendations for surface conditions.
- .2 Sealants: in accordance with Section 07 92 00 - Joint Sealants.

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, maintenance and as recommended by manufacturer and National Fire Code of Canada, CAN/CSA B139.
- .2 Provide space for disassembly, removal of equipment and components as recommended by manufacturer, CAN/CSA B139 without interrupting operation of other system, equipment, components.

3.4 DRAINS

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

3.5 AIR VENTS

- .1 Install manual air vents to CAN/CSA B139, at high points in piping systems.
- .2 Install isolating valve at each automatic air valve.
- .3 Install drain piping to approved location and terminate where discharge is visible.

3.6 DIELECTRIC COUPLINGS

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

3.7 PIPEWORK INSTALLATION

- .1 Install pipework to CAN/CSA B139.
- .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 Saddle type branch fittings may be used on mains if branch line is no larger than half size of main.
 - .1 Hole saw (or drill) and ream main to maintain full inside diameter of branch line prior to welding saddle.
- .7 Install exposed piping, equipment, rectangular cleanouts and similar items parallel or perpendicular to building lines.
- .8 Install concealed pipework to minimize furring space, maximize headroom, conserve space.
- .9 Slope piping, except where indicated, in direction of flow for positive drainage and venting.
- .10 Install, except where indicated, to permit separate thermal insulation of each pipe.
- .11 Group piping wherever possible.
- .12 Ream pipes, remove scale and other foreign material before assembly.
- .13 Use eccentric reducers at pipe size changes to ensure positive drainage and venting.
- .14 Provide for thermal expansion as indicated.
- .15 Valves:
 - .1 Install in accessible locations.
 - .2 Remove interior parts before soldering.
 - .3 Install with stems above horizontal position unless indicated.
 - .4 Valves accessible for maintenance without removing adjacent piping.

- .5 Install globe valves in bypass around control valves.
- .6 Use gate or ball valves at branch take-offs for isolating purposes except where specified.
- .7 Use chain operators on valves NPS 2 1/2 and larger where installed more than 2400 mm above floor in Mechanical Rooms.
- .16 Check Valves:
 - .1 Install silent check valves on discharge of pumps and in vertical pipes with downward flow.
 - .2 Install swing check valves in horizontal lines on discharge of pumps.

3.8 SLEEVES

- .1 General: install where pipes pass through masonry, concrete structures, fire rated assemblies, and as indicated.
- .2 Material: schedule 40 black steel pipe.
- .3 Construction: use annular fins continuously welded at mid-point at foundation walls and where sleeves extend above finished floors.
- .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.
- .6 Sealing:
 - .1 Foundation walls and below grade floors: fire retardant, waterproof non-hardening mastic.
 - .2 Sleeves installed for future use: fill with lime plaster or other easily removable filler.
 - .3 Ensure no contact between copper pipe or tube and sleeve.

3.9 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 relevant mechanical Sections.
- .2 Preparatory to acceptance, clean and refurbish equipment and leave in operating condition, including replacement of filters in piping systems.

3.10 PRESSURE TESTING OF EQUIPMENT AND PIPEWORK

- .1 Advise DCC Representative 48 hours minimum prior to performance of pressure tests.
- .2 Pipework: test as specified in relevant sections of heating, ventilating and air conditioning work.

- .3 Maintain specified test pressure without loss for 4 hours minimum unless specified for longer period of time in relevant mechanical sections.
- .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 DCC Representative.
- .6 Pay costs for repairs or replacement, retesting, and making good. DCC Representative to determine whether repair or replacement is appropriate.
- .7 Insulate or conceal work only after approval and certification of tests by DCC Representative.

3.11 EXISTING SYSTEMS

- .1 Connect into existing piping systems at times approved by DCC Representative.
- .2 Request written approval by DCC Representative ten (10) workdays minimum, prior to commencement of work.
- .3 Be responsible for damage to existing plant by this work.

3.12 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 19 - Waste Management and Disposal.

END OF SECTION

Part 1 General

1.1 REFERENCE STANDARDS

- .1 American National Standards Institute/American Society of Mechanical Engineers (ANSI/ASME):
 - .1 ANSI/ASME B31.1-2007, Power Piping.
 - .2 ANSI/ASME B31.3-2006, Process Piping.
 - .3 ANSI/ASME Boiler and Pressure Vessel Code-2007.
 - .1 BPVC 2007 Section I: Power Boilers.
 - .2 BPVC 2007 Section V: Nondestructive Examination.
 - .3 BPVC 2007 Section IX: Welding and Brazing Qualifications.
- .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 C1.1M/C1.1-2000, Recommended Practices for Resistance Welding.
 - .2 AWS Z49.1-2005, Safety in Welding, Cutting and Allied Process.
 - .3 AWS W1-2000, Welding Inspection Handbook.
- .4 CSA Group (CSA):
 - .1 CSA W47.2-M1987, 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, 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

1.2 ACTION AND INFORMATIONAL SUBMITTALS

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

1.3 QUALITY ASSURANCE

- .1 Qualifications:
 - .1 Welders:
 - .1 Welding qualifications in accordance with CSA B51.
 - .2 Use qualified and licensed welders possessing certificate for each procedure performed from authority having jurisdiction.
 - .3 Submit welder's qualifications to DCC 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.
- .2 Inspectors:
 - .1 Inspectors qualified to CSA W178.2.
- .3 Certifications:
 - .1 Registration of welding procedures in accordance with CSA B51.
 - .2 Copy of welding procedures available for inspection.
 - .3 Safety in welding, cutting and allied processes in accordance with CSA-W117.2.

1.4 DELIVERY, STORAGE, AND HANDLING

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

Part 2 Products

2.1 ELECTRODES

- .1 Electrodes: in accordance with CSA W48 Series

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 QUALITY OF WORK

- .1 Welding: in accordance with ANSI/ASME B31.1, B31.3, ANSI/ASME Boiler and Pressure Vessel Code, Sections I and IX and ANSI/AWWA C206, using procedures conforming to AWS B3.0, AWS C1.1, and special procedures specified elsewhere in Division 23 and applicable requirements of provincial authority having jurisdiction.

3.3 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.

3.4 INSPECTION AND TESTS - GENERAL REQUIREMENTS

- .1 Review weld quality requirements and defect limits of applicable codes and standards with DCC Representative before work is started.
- .2 Formulate "Inspection and Test Plan" in cooperation with DCC 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 and approved by DCC Representative.
 - .2 To ANSI/ASME Boiler and Pressure Vessels Code, Section V, CSA B51 and requirements of authority having jurisdiction.
 - .3 Inspect and test 100% of welds in accordance with "Inspection and Test Plan" by non-destructive visual examination and magnetic particle (hereinafter referred to as "particle") tests and spot or full gamma ray radiographic (hereinafter referred to as "radiography") tests.
- .2 Hydrostatically test welds to ANSI/ASME B31.1.
- .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 DCC Representative of total of up to 30% of welds, selected at random by DCC Representative by radiographic tests.
- .5 Full radiographic tests for piping systems.
 - .1 Spot radiography:
 - .1 Conduct spot radiographic tests of up to 30% of welds, selected at random by DCC Representative from welds which would be most difficult to repair in event of failure after system is operational.
 - .2 Radiographic film:
 - .1 Identify each radiographic film with date, location, name of welder, and submit to DCC Representative. Replace film if rejected because of poor quality.
 - .3 Interpretation of radiographic films:
 - .1 By qualified radiographer.
 - .4 Failure of radiographic tests:
 - .1 Extend tests to welds by welder responsible when those welds fails tests.

- .6 Magnetic particle tests for piping systems as indicated.

3.6 DEFECTS CAUSING REJECTION

- .1 As described in ANSI/ASME B31.1 and ANSI/ASME Boiler and Pressure Vessels Code

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.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 23 05 15 Common Installation Requirements for HVAC Pipework.

1.2 REFERENCE STANDARDS

- .1 American Society of Mechanical Engineers (ASME)
 - .1 [ASME B40.100-2013](#), Pressure Gauges and Gauge Attachments.
 - .2 [ASME B40.200-2008\(R2013\)](#), Thermometers, Direct Reading and Remote Reading.
- .2 Canadian General Standards Board (CGSB)
 - .1 [CAN/CGSB-14.4-M88](#), Thermometers, Liquid-in-Glass, Self Indicating, Commercial/Industrial Type.
 - .2 [CAN/CGSB-14.5-M88](#), Thermometers, Bimetallic, Self-Indicating, Commercial/Industrial Type.
- .3 Efficiency Valuation Organization (EVO)
 - .1 International Performance Measurement and Verification Protocol (IPMVP)
 - .1 IPMVP 2012 Version.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for thermometers and pressure gauges and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Certificates:
 - .1 Submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
- .4 Test and Evaluation Reports:
 - .1 Submit certified test reports for thermometers and pressure gauges from approved independent testing laboratories, indicating compliance with specifications for specified performance characteristics and physical properties.

1.4 DELIVERY, STORAGE AND HANDLING

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

- .1 Store thermometers and pressure gauges in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
- .2 Store and protect thermometers and pressure gauges from nicks, scratches, and blemishes.
- .3 Replace defective or damaged materials with new.
- .4 Develop Construction Waste Management Plan.
- .5 Packaging Waste Management: remove for reuse and return by manufacturer of pallets, crates, padding, and packaging materials as specified in Construction Waste Management Plan.

Part 2 Products

2.1 GENERAL

- .1 Design point to be at mid-point of scale or range.
- .2 Ranges: as indicated.

2.2 PRESSURE GAUGES

- .1 112 mm, dial type: to [ASME B40.100](#), Grade 2A, phosphor bronze bourdon tube having 0.5% accuracy full scale unless otherwise specified.
- .2 Provide:
 - .1 Snubber for pulsating operation.
 - .2 Gasketed pressure relief back with solid front.
 - .3 Bronze stop cock.
 - .4 Oil filled for high vibration applications.

Part 3 Execution

3.1 EXAMINATION

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

3.2 GENERAL

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

3.3 PRESSURE GAUGES

- .1 Install in locations as follows:
 - .1 Suction and discharge of pumps.
 - .2 Upstream and downstream of PRV's.
 - .3 Upstream and downstream of control valves.
 - .4 Inlet and outlet of coils.
 - .5 Inlet and outlet of liquid side of heat exchangers.
 - .6 In other locations as indicated.
- .2 Install gauge cocks for balancing purposes, elsewhere as indicated.
- .3 Use extensions where pressure gauges are installed through insulation.

3.4 NAMEPLATES

- .1 Install engraved lamacoid nameplates, identifying medium.

3.5 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.
 - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.
- .3 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 19 Waste Management and Disposal.
 - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

3.6 PROTECTION

- .1 Protect installed products and components from damage during construction.
- .2 Repair damage to adjacent materials caused by thermometer and gauge installation.

END OF SECTION

Part 1 GENERAL

1.1 RELATED REQUIREMENTS

- .1 Section 23 05 15 Common Installation Requirements for HVAC Pipework.

1.2 REFERENCE STANDARDS

- .1 American National Standards Institute (ANSI)/American Society of Mechanical Engineers (ASME)
 - .1 [ANSI/ASME B1.20.1-2013\(R2018\)](#), Pipe Threads, General Purpose (Inch).
 - .2 [ANSI/ASME B16.18-2018](#), Cast Copper Alloy Solder Joint Pressure Fittings.
- .2 ASTM International (ASTM)
 - .1 [ASTM A 276/A 276M-2017](#), Standard Specification for Stainless Steel Bars and Shapes.
 - .2 [ASTM B 62-2017](#), Standard Specification for Composition Bronze or Ounce Metal Castings.
 - .3 [ASTM B 283/B 283M-2020](#), Standard Specification for Copper and Copper Alloy Die Forgings (Hot-Pressed).
 - .4 [ASTM B 505/B 505M-2018](#), Standard Specification for Copper-Base Alloy Continuous Castings.
- .3 Manufacturers Standardization Society of the Valve and Fittings Industry, Inc. (MSS)
 - .1 MSS-SP-25-2018, Standard Marking System for Valves, Fittings, Flanges and Unions.
 - .2 MSS-SP-80-2019, Bronze Gate Globe, Angle and Check Valves.
 - .3 MSS-SP-110-2010, Ball Valves, Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends.

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 data sheets for equipment and systems and include product characteristics, performance criteria, physical size, finish and limitations.
 - .2 Submit WHMIS SDS - Safety Data Sheets.
- .3 Shop Drawings:
 - .1 Submit drawings stamped and signed by professional engineer registered or licensed in Ontario, Canada.
 - .2 Submit data for valves specified in this Section.

1.4 CLOSEOUT SUBMITTALS

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

1.5 MAINTENANCE MATERIAL SUBMITTALS

- .1 Extra Materials/Spare Parts:
 - .1 Furnish following spare parts:
 - .1 Valve seats: one for every 10 valves each size, minimum 1.
 - .2 Discs: one for every 10 valves, each size. Minimum 1.
 - .3 Stem packing: one for every 10 valves, each size. Minimum 1.
 - .4 Valve handles: 2 of each size.
 - .5 Gaskets for flanges: one for every 10 flanged joints.
 - .2 Tools:
 - .1 Furnish special tools for maintenance of systems and equipment.
 - .2 Include following:
 - .1 Lubricant gun for expansion joints.

1.6 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements:
 - .1 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.
- .3 Packaging Waste Management: remove for reuse and return by manufacturer of pallets, crates, padding, and packaging materials in accordance with Section 01 74 19 Waste Management and Disposal.

Part 2 Products

2.1 MATERIALS

- .1 Valves:
 - .1 Except for specialty valves, to be single manufacturer.
 - .2 Products to have CRN registration numbers.
- .2 End Connections:
 - .1 Connection into adjacent piping/tubing:
 - .1 Steel pipe systems: screwed ends to ANSI/ASME B1.20.1.
 - .2 Copper tube systems: solder ends or grooved ends to ANSI/ASME B16.18.
- .3 Lockshield Keys:
 - .1 Where lockshield valves are specified, provide 10 keys of each size: malleable iron cadmium plated.
- .4 Gate Valves:
 - .1 Requirements common to gate valves, unless specified otherwise:

- .1 Standard specification: MSS SP-80.
- .2 Bonnet: union with hexagonal shoulders.
- .3 Connections: screwed with hexagonal shoulders.
- .4 Inspection and pressure testing: to MSS SP-80. Tests to be hydrostatic.
- .5 Packing: non-asbestos.
- .6 Handwheel: non-ferrous.
- .7 Handwheel Nut: bronze to [ASTM B 62](#).
- .2 NPS 2 and under, non-rising stem, solid wedge disc, Class 150:
 - .1 Body: with long disc guides, screwed bonnet with stem retaining nut.
 - .2 Operator: handwheel.
- .3 NPS 2 and under, rising stem, solid wedge disc, Class 150:
 - .1 Body: with long disc guides, screwed union bonnet.
 - .2 Operator: handwheel.
- .5 Check Valves:
 - .1 Requirements common to check valves, unless specified otherwise:
 - .1 Standard specification: MSS SP-80.
 - .2 Connections: screwed with hexagonal shoulders.
 - .2 NPS 2 and under, swing type, composition disc, Class 200:
 - .1 Body: Y-pattern with integral seat at 45 degrees, screw-in cap with hex head.
 - .2 Disc: renewable rotating disc of number 6 composition to suit service conditions, bronze two-piece hinge disc construction.
 - .3 NPS 2 and under, horizontal lift type, composition disc, Class 150:
 - .1 Body: with integral seat, union bonnet ring with hex shoulders, cap.
 - .2 Disc: renewable PTFE rotating disc in disc holder having guides top and bottom, of bronze to [ASTM B 62](#).
- .6 Ball Valves:
 - .1 NPS 2 and under:
 - .1 Body and cap: cast high tensile bronze to [ASTM B 62](#).
 - .2 Pressure rating: Class 125.
 - .3 Connections: screwed ends to ANSI B1.20.1 and with hexagonal shoulders.
 - .4 Stem: tamperproof ball drive.
 - .5 Stem packing nut: external to body.
 - .6 Ball and seat: replaceable stainless steel solid ball and Teflon seats.
 - .7 Stem seal: TFE with external packing nut.
 - .8 Operator: removable lever handle.
- .7 Butterfly Valves:
 - .1 NPS 2 1/2 through NPS 6, 2068 kPa with grooved ends.
 - .1 Body: cast bronze, with copper-tube dimensioned grooved ends.
 - .2 Disc: elastomer coated ductile iron with integrally cast stem.
 - .3 Operator: lever.

Part 3 Execution

3.1 INSTALLATION

- .1 Install rising stem valves in upright position with stem above horizontal.
- .2 Remove internal parts before soldering.
- .3 Install valves with unions at each piece of equipment arranged to allow servicing, maintenance, and equipment removal.

3.2 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 19 Waste Management and Disposal.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 21 13 13 Wet Pipe Fire Protection Systems.
- .2 Section 23 05 15 Common Installation Requirements for HVAC Pipework.

1.2 REFERENCE STANDARDS

- .1 American Society of Mechanical Engineers (ASME)
 - .1 [ASME B16.1-2020](#), Cast Iron Pipe Flanges and Flanged Fittings.
- .2 ASTM International (ASTM).
 - .1 [ASTM A 49-2012\(r2019\)](#), Standard Specification for Heat-Treated Carbon Steel Joint Bars.
 - .2 [ASTM A 126-2004\(r2019\)](#), Standard Specification for Grey Iron Castings for Valves, Flanges, and Pipe Fittings.
 - .3 [ASTM A 536-84\(r2019e1\)](#), Standard Specification for Ductile Iron Castings.
 - .4 [ASTM B 61-2015\(r2021\)](#), Standard Specification for Steam or Valve Bronze Castings.
 - .5 [ASTM B 62-2017](#), Standard Specification for Composition Bronze or Ounce Metal Castings.
 - .6 [ASTM B 85/B 85M-2018\(e01\)](#), Standard Specification for Aluminum-Alloy Die Castings.
 - .7 [ASTM B 209/B 209M-2021a](#), Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
- .3 Manufacturers Standardization Society of the Valve and Fittings Industry, Inc. (MSS)
 - .1 MSS SP-61-2019, Pressure Testing of Steel Valves.
 - .2 MSS SP-70-2011, Grey Iron Gate Valves, Flanged and Threaded Ends.
 - .3 MSS SP-71-2018, Grey Iron Swing Check Valves, Flanged and Threaded Ends.
 - .4 MSS SP-82-1992, Valve Pressure Testing Methods.
 - .5 MSS SP-85-2011, Cast Iron Globe and Angle Valves, Flanged and Threaded Ends.

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 valves and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Shop Drawings:
 - .1 Submit drawings stamped and signed by professional engineer registered or licensed in Ontario, Canada.

1.4 CLOSEOUT SUBMITTALS

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

1.5 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements:
 - .1 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.
- .3 Packaging Waste Management: remove for reuse and return by manufacturer of pallets crates padding and packaging materials in accordance with Section 01 74 19 Waste Management and Disposal.

1.6 MAINTENANCE MATERIAL SUBMITTALS

- .1 Extra Materials/Spare Parts:
- .2 Furnish following spare parts:
 - .1 Valve seats: one for every 10 valves each size, minimum 1.
 - .2 Discs: one for every 10 valves, each size, minimum 1.
 - .3 Stem packing: one for every 10 valves, each size, minimum 1.
 - .4 Valve handles: 2 of each size.
 - .5 Gaskets for flanges: one for every 10 flanged joints.
- .3 Tools:
 - .1 Furnish special tools for maintenance of systems and equipment.
 - .2 Include following:
 - .1 Lubricant gun for expansion joints.

Part 2 Products

2.1 MATERIAL

- .1 Valves:
 - .1 Except for specialty valves, to be of single manufacturer.
- .2 Standard specifications:
 - .1 Gate valves: MSS SP-70.
 - .2 Globe valves: MSS SP-85.
 - .3 Check valves: MSS SP-71.
- .3 Requirements common to valves, unless specified otherwise:
 - .1 Body, bonnet: cast iron to [ASTM B 209](#) Class B.

- .2 Connections: flanged ends plain face to ANSI B16.1.
- .3 Inspection and pressure testing: to MSS SP-82.
- .4 Bonnet gasket: non-asbestos.
- .5 Stem: to have precision-machined Acme or 60 degrees V threads, top screwed for handwheel nut.
- .6 Stuffing box: non-galling two-piece ball-jointed packing gland, gland bolts and nuts.
- .7 Gland packing: non-asbestos.
- .8 Handwheel: die-cast aluminum alloy to [ASTM B 85/B 85M](#) or malleable iron to [ASTM A 49](#). Nut of bronze to [ASTM B 62](#).
- .9 Identification tag: with catalogue number, size, other pertinent data.
- .4 All products to have CRN registration numbers.

2.2 GATE VALVES

- .1 NPS 2 1/2-8, outside screw and yoke (OS&Y), bronze trim, solid wedge disc:
 - .1 Body and multiple-bolted bonnet: with bosses in body and bonnet for taps and drains, full length disc guides designed to ensure correct re-assembly, yoke, yoke hub, yoke sleeve and nut. Class 125.
 - .2 Disc: solid offset taper wedge, bronze to [ASTM B 62](#) up to NPS 3, cast iron with bronze disc rings on other sizes, secured to stem through integral forged T-head disc-stem connection.
 - .3 Seat rings: renewable bronze screwed into body.
 - .4 Stem: nickel-plated steel.
 - .5 Disc: solid offset taper all-cast iron, secured to stem through integral forged T-head disc-stem connection.
 - .6 Seat rings: integral with body.
 - .7 Stem: nickel-plated steel.
 - .8 Pressure-lubricated operating mechanism.
 - .9 Operator: handwheel.
 - .10 Bypass: complete with union and gate valve as Section 23 05 15 Common Installation Requirements for HVAC Pipework.
- .2 NPS 10 - 24, outside screw and yoke (OS&Y), bronze trim, solid wedge disc:
 - .1 Body and multiple-bolted bonnet: NPS 10 - 14: cast iron to [ASTM A 126](#) Class B. With bosses in body and bonnet for taps and drains, full length disc guides designed to ensure correct re-assembly, body tie ribs between bonnet and end flanges, yoke, yoke hub, yoke sleeve and nut.
 - .2 Pressure ratings: Class 125.
 - .1 NPS 10-12: WP = 1.4 Mpa CWP.
 - .2 NPS 14-24: WP = 1.03 Mpa CWP.
 - .3 Disc: solid offset taper wedge, bronze disc rings to [ASTM B 62](#) rolled into cast iron disc, secured to stem through integral forged T-head disc-stem connection.
 - .4 Seat rings: renewable bronze to [ASTM B 62](#) screwed into body.
 - .5 Stem: nickel-plated steel.

- .6 Disc: solid offset taper all-cast iron, secured to stem through integral forged T-head disc-stem connection.
- .7 Seat: integral with body up to NPS 14, renewable nodular iron on other sizes.
- .8 Stem: nickel-plated steel.
- .9 Pressure-lubricated operating mechanism.
- .10 Operator: handwheel.
- .11 Bypass: complete with union and gate valve as Section 23 05 23.01 - Valves - Bronze.

2.3 UNDERWRITERS APPROVED GATE VALVE

- .1 NPS 2 1/2 - 14, OS&Y:
 - .1 Approvals: UL and FM approved for fire service.
 - .2 UL and FM Label: on valve yoke.
 - .3 Body, Bonnet: cast iron to [ASTM A 126](#) Class B. Wall thicknesses to **ANSI B16.1** and ULC C-262 (B).
 - .4 Bonnet bushing, yoke sleeve: bronze, to FM requirements.
 - .5 Packing gland: bronze.
 - .6 Stem: manganese bronze. Diameter to ULC C-262 (B).
 - .7 Stuffing box dimensions, gland bolt diameter: to ULC C-262 (B).
 - .8 Bosses for bypass valve, drain: on NPS 4 and over.
 - .9 Disc: solid taper wedge. Up to NPS 3: bronze. NPS 4 and over: EPDM coated cast iron with bronze disc rings.
 - .10 Disc seat ring: self-aligning, Milwood undercut on NPS 3 - 12.
 - .11 Pressure rating:
 - .1 NPS 2-1/2 - 12: 1.7 Mpa CWP.
 - .2 NPS 14-1.2: 1.2 MPa CWP.
 - .12 Operator: handwheel.
 - .13 Bypass: complete with union and gate valve as Section 23 05 23.01 - Valves - Bronze.

2.4 VALVE OPERATORS

- .1 Install valve operators as follows:
 - .1 Handwheel: on valves except as specified.
 - .2 Handwheel with chain operators: on valves installed more than 2400 mm above floor in mechanical equipment rooms.

2.5 CHECK VALVES

- .1 Swing check valves, NPS 2 1/2 - 8 Class 250:
 - .1 Body and bolted cover: cast iron to [ASTM A 126](#) Class B with tapped and plugged opening on each side for hinge pin.
 - .2 Flanged ends: 2 mm raised face with serrated finish.
 - .3 Rating: 250 psi steam; 500 psi CWP.
 - .4 Disc: rotating for extended life.
 - .1 Up to NPS 3: bronze to [ASTM B 61](#).

- .2 NPS 4 - 8: iron faced with [ASTM B 61](#) bronze.
- .5 Seat rings: renewable bronze to [ASTM B 61](#), screwed into body.
- .6 Hinge pin, bushings: renewable, bronze to [ASTM B 61](#).
- .7 Hinge: galvanized malleable iron.
- .8 Identification tag: fastened to cover.

2.6 SILENT CHECK VALVES

- .1 Construction:
 - .1 Body: malleable or ductile iron with integral seat.
 - .2 Pressure rating: Class 125, WP = 860 kPa.
 - .3 Connections: grooved ends.
 - .4 Disc: bronze or stainless steel renewable rotating disc.
 - .5 Seat: renewable, EPDM.
 - .6 Stainless steel spring, heavy duty.

Part 3 Execution

3.1 INSTALLATION

- .1 Install rising stem valves in upright position with stem above horizontal.

3.2 CLEANING

- .1 Clean in accordance with Section 01 74 11 - Cleaning.
- .2 Clean installed products in accordance with manufacturer's recommendation.
- .3 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 19 Waste Management and Disposal.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 03 30 00 - Cast-in-Place Concrete
- .2 Section 23 05 48 - Vibration and Seismic Controls for HVAC Piping.

1.2 REFERENCE STANDARDS

- .1 American Society of Mechanical Engineers (ASME):
 - .1 ASME B31.1-07, Power Piping
- .2 ASTM International (ASTM):
 - .1 ASTM A 125-1996(2018), Standard Specification for Steel Springs, Helical, Heat-Treated
 - .2 ASTM A 307-14, Standard Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength
 - .3 ASTM A 563-15, Standard Specification for Carbon and Alloy Steel Nuts
- .3 Manufacturer's Standardization Society of the Valves and Fittings Industry (MSS):
 - .1 MSS SP 58-2002, Pipe Hangers and Supports - Materials, Design and Manufacture
 - .2 MSS SP 69-2003, Pipe Hangers and Supports - Selection and Application
 - .3 MSS SP 89-2003, Pipe Hangers and Supports - Fabrication and Installation Practices
- .4 National Research Council Canada (NRC):
 - .1 National Plumbing Code of Canada 2020 (NPC).

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 data sheets for hangers and supports and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Shop Drawings:
 - .1 Submit drawings stamped and signed by professional engineer registered or licensed in Province of Ontario, Canada.
 - .2 Submit shop drawings for:
 - .1 Bases, hangers and supports.
 - .2 Connections to equipment and structure.
 - .3 Structural assemblies.
- .4 Certificates:

- .1 Submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
- .5 Manufacturers' Instructions:
 - .1 Provide manufacturer's installation instructions.

1.4 CLOSEOUT SUBMITTALS

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

1.5 DELIVERY, STORAGE, AND HANDLING

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

Part 2 Products

2.1 SYSTEM DESCRIPTION

- .1 Design Requirements:
 - .1 Construct pipe hanger and support to manufacturer's recommendations utilizing manufacturer's regular production components, parts and assemblies.
 - .2 Base maximum load ratings on allowable stresses prescribed by ASME B31.1 or MSS SP 58
 - .3 Ensure that supports, guides, anchors do not transmit excessive quantities of heat to building structure.
 - .4 Design hangers and supports to support systems under conditions of operation, allow free expansion and contraction, prevent excessive stresses from being introduced into pipework or connected equipment.
 - .5 Provide for vertical adjustments after erection and during commissioning. Amount of adjustment in accordance with MSS SP 58
- .2 Performance Requirements:
 - .1 Design supports, platforms, hangers to withstand seismic events as specified Section 23 05 48 – Vibration and Seismic Controls for HVAC Piping.

2.2 GENERAL

- .1 Fabricate hangers, supports and sway braces in accordance with MSS SP 58 and ANSI B31.1.
- .2 Use components for intended design purpose only. Do not use for rigging or erection purposes.

2.3 PIPE HANGERS

- .1 Finishes:
 - .1 Pipe hangers and supports: painted with zinc-rich paint after manufacture.
 - .2 Use electro-plating galvanizing process or hot dipped galvanizing process.

- .3 Ensure steel hangers in contact with copper piping are copper plated or epoxy coated.
- .2 Upper attachment structural: suspension from lower flange of I-Beam:
 - .1 Cold piping NPS 2 maximum: malleable iron C-clamp with hardened steel cup point setscrew, locknut and carbon steel retaining clip.
 - .1 Rod: 9 mm UL listed, 13 mm FM approved.
 - .2 Cold piping NPS 2 1/2 or greater, hot piping: malleable iron beam clamp, eye rod, jaws and extension with carbon steel retaining clip, tie rod, nuts and washers, UL listed, FM approved, to MSS-SP 58 and MSS-SP 69.
- .3 Upper attachment structural: suspension from upper flange of I-Beam:
 - .1 Cold piping NPS 2 maximum: ductile iron top-of-beam C-clamp with hardened steel cup point setscrew, locknut and carbon steel retaining clip, UL listed, FM approved, to MSS SP 69.
 - .2 Cold piping NPS 2 1/2 or greater, hot piping: malleable iron top-of-beam jaw-clamp with hooked rod, spring washer, plain washer and nut UL listed, FM approved.
- .4 Upper attachment to concrete:
 - .1 Ceiling: carbon steel welded eye rod, clevis plate, clevis pin and cotters with weldless forged steel eye nut. Ensure eye 6 mm minimum greater than rod diameter.
 - .2 Concrete inserts: wedge shaped body with knockout protector plate UL listed, FM approved to MSS SP 69.
- .5 Shop and site-fabricated assemblies:
 - .1 Trapeze hanger assemblies: MSS SP-58.
 - .2 Steel brackets: MSS SP-58.
 - .3 Sway braces for seismic restraint systems: to Section 23 05 48 – Vibration and Seismic Controls for HVAC Piping.
- .6 Hanger rods: threaded rod material to MSS SP 58:
 - .1 Ensure that hanger rods are subject to tensile loading only.
 - .2 Provide linkages where lateral or axial movement of pipework is anticipated.
 - .3 Do not use 22 mm or 28 mm rod.
- .7 Pipe attachments: material to MSS SP 58:
 - .1 Attachments for steel piping: carbon steel galvanized.
 - .2 Attachments for copper piping: copper plated black steel.
 - .3 Use insulation shields for hot pipework.
 - .4 Oversize pipe hangers and supports.
- .8 Adjustable clevis: material to MSS SP 69, UL listed, FM approved, clevis bolt with nipple spacer and vertical adjustment nuts above and below clevis.
 - .1 Ensure "U" has hole in bottom for rivetting to insulation shields.
- .9 Yoke style pipe roll: carbon steel yoke, rod and nuts with cast iron roll, to MSS SP 69
- .10 U-bolts: carbon steel to MSS SP 69 with 2 nuts at each end to ASTM A 563

- .1 Finishes for steel pipework: galvanized.
- .2 Finishes for copper, glass, brass or aluminum pipework: black, with formed portion plastic coated or epoxy coated.
- .11 Pipe rollers: cast iron roll and roll stand with carbon steel rod to MSS SP 69

2.4 RISER CLAMPS

- .1 Steel or cast iron pipe: galvanized carbon steel to MSS SP 58, type 42, UL listed, FM approved.
- .2 Copper pipe: carbon steel copper plated to MSS SP 58, type 42.
- .3 Bolts: to ASTM A 307
- .4 Nuts: to ASTM A 563

2.5 INSULATION PROTECTION SHIELDS

- .1 Insulated cold piping:
 - .1 64 kg/m³ density insulation plus insulation protection shield to: MSS SP 69, galvanized sheet carbon steel. Length designed for maximum 3 m span.
- .2 Insulated hot piping:
 - .1 Curved plate 300 mm long, with edges turned up, welded-in centre plate for pipe sizes NPS 12 and over, carbon steel to comply with MSS SP 69.

2.6 CONSTANT SUPPORT SPRING HANGERS

- .1 Springs: alloy steel to ASTM A 125, shot peened, magnetic particle inspected, with +/-5% spring rate tolerance, tested for free height, spring rate, loaded height and provided with Certified Mill Test Report (CMTR)
- .2 Load adjustability: 10% minimum adjustability each side of calibrated load. Adjustment without special tools. Adjustments not to affect travel capabilities.
- .3 Provide upper and lower factory set travel stops.
- .4 Provide load adjustment scale for site adjustments.
- .5 Total travel to be actual travel + 20%. Difference between total travel and actual travel 25 mm minimum.
- .6 Individually calibrated scales on each side of support calibrated prior to shipment, complete with calibration record.

2.7 VARIABLE SUPPORT SPRING HANGERS

- .1 Vertical movement: 13 mm minimum, 50 mm maximum, use single spring pre-compressed variable spring hangers.

- .2 Vertical movement greater than 50 mm: use double spring pre-compressed variable spring hanger with 2 springs in series in single casing.
- .3 Variable spring hanger complete with factory calibrated travel stops. Provide certificate of calibration for each hanger.
- .4 Steel alloy springs: to ASTM A 125, shot peened, magnetic particle inspected, with +/-5 % spring rate tolerance, tested for free height, spring rate, loaded height and provided with CMTR

2.8 EQUIPMENT ANCHOR BOLTS AND TEMPLATES

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

2.9 HOUSE-KEEPING PADS

- .1 Provide 100 mm high concrete housekeeping pads for base-mounted equipment; size pads 50 mm larger than equipment; chamfer pad edges.
- .2 Concrete: to Section 03 30 00 - Cast-in-Place Concrete.

Part 3 Execution

3.1 MANUFACTURER'S INSTRUCTIONS

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

3.2 INSTALLATION

- .1 Install in accordance with:
 - .1 Manufacturer's instructions and recommendations.
- .2 Vibration Control Devices:
 - .1 Install on piping systems at pumps, and as indicated.
- .3 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.
- .4 Clevis plates:
 - .1 Attach to concrete with 4 minimum concrete inserts, one at each corner.
- .5 Provide supplementary structural steelwork where structural bearings do not exist or where concrete inserts are not in correct locations.

- .6 Use approved constant support type hangers where:
 - .1 Vertical movement of pipework is 13 mm or more,
 - .2 Transfer of load to adjacent hangers or connected equipment is not permitted.
- .7 Use variable support spring hangers where:
 - .1 Transfer of load to adjacent piping or to connected equipment is not critical.
 - .2 Variation in supporting effect does not exceed 25 % of total load.

3.3 HANGER SPACING

- .1 Plumbing piping: to National Plumbing Code of Canada (NPC), Provincial Code, authority having jurisdiction.
- .2 Fire protection: to applicable fire code.
- .3 Gas and fuel oil piping: up to NPS 1/2: every 1.8 m.
- .4 Copper piping: up to NPS 1/2: every 1.5 m.
- .5 Flexible joint roll groove pipe: in accordance with table below for steel, but not less than one hanger at joints. Table listings for straight runs without concentrated loads and where full linear movement is not required.
- .6 Within 300 mm of each elbow.

<u>Maximum Pipe Size: NPS</u>	<u>Maximum Spacing Steel</u>	<u>Maximum Spacing Copper</u>
up to 1-1/4	2.4 m	1.8 m
1-1/2	3.0 m	2.4 m
2	3.0 m	2.4 m
2-1/2	3.7 m	3.0 m
3	3.7 m	3.0 m
3-1/2	3.7 m	3.3 m
4	3.7 m	3.6 m
5	4.3 m	
6	4.3 m	
8	4.3 m	
10	4.9 m	
12	4.9 m	

- .7 Pipework greater than NPS 12: to MSS SP 69

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.

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 CLEANING

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

END OF SECTION

Part 1 General

1.1 SUMMARY

- .1 Section Includes:
 - .1 Vibration isolation materials and components, seismic control measures and their installation.

1.2 REFERENCE STANDARDS

- .1 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
 - .1 Safety Data Sheets (SDS)
- .2 National Fire Protection Association (NFPA)
 - .1 NFPA 13-2022, Standard for the Installation of Sprinkler Systems.
- .3 National Research Council Canada (NRC)
 - .1 National Building Code of Canada 2020 (NBC).

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submittals: in accordance with Section 01 33 00 - Submittal Procedures.
 - .1 Submit manufacturer's printed product literature, specifications and datasheet in accordance with Section 01 33 00 - Submittal Procedures. Include product characteristics, performance criteria, and limitations.
 - .1 Submit two copies of Workplace Hazardous Materials Information System (WHMIS) Safety Data Sheets (SDS) in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Submit shop drawings in accordance with Section 01 33 00 - Submittal Procedures.
 - .1 Shop drawings: Submit drawings stamped and signed by professional engineer registered or licensed in Province of Ontario, Canada.
 - .2 Provide system shop drawings complete with performance and product data.
 - .3 Provide detailed drawings of seismic control measures for equipment and piping.
- .3 Quality assurance submittals: submit following in accordance with Section 01 33 00 - Submittal Procedures.
 - .1 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
 - .2 Instructions: submit manufacturer's installation instructions.

1.4 QUALITY ASSURANCE

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

1.5 DELIVERY, STORAGE, AND HANDLING

- .1 Packing, shipping, handling and unloading:
 - .1 Deliver, store and handle in accordance with Section 01 61 00 - Common Product Requirements.
 - .2 Deliver, store and handle materials in accordance with manufacturer's written instructions.
- .2 Waste Management and Disposal:
 - .1 Waste Management and Disposal: separate waste materials for reuse and recycling in accordance with Section 01 74 19 - Waste Management and Disposal.

Part 2 Products

2.1 GENERAL

- .1 Size and shape of bases type and performance of vibration isolation as indicated.

2.2 SPRINGS

- .1 Design stable springs: ratio of lateral to axial stiffness is equal to or greater than 1.2 times ratio of static deflection to working height. Select for 50% travel beyond rated load. Units complete with levelling devices.
- .2 Ratio of height when loaded to diameter of spring between 0.8 to 1.0.
- .3 Cadmium plate for 100% relative humidity installations.
- .4 Colour code springs.

2.3 HANGERS

- .1 Colour coded springs, rust resistant, painted box type hangers. Arrange to permit hanger box or rod to move through a 30 degrees arc without metal to metal contact.
- .2 Type H1 - neoprene - in-shear, moulded with rod isolation bushing which passes through hanger box.
- .3 Type H2 - stable spring, elastomeric washer, cup with moulded isolation bushing which passes through hanger box.
- .4 Type H3 - stable spring, elastomeric element, cup with moulded isolation bushing which passes through hanger box.
- .5 Type H4 - stable spring, elastomeric element with precompression washer and nut with deflection indicator.

2.4 SEISMIC CONTROL MEASURES

- .1 General:

- .1 Seismic control systems to work in every direction.
- .2 Fasteners and attachment points to resist same maximum load as seismic restraint.
- .3 Drilled or power driven anchors and fasteners not permitted.
- .4 No equipment, equipment supports or mounts to fail before failure of structure.
- .5 Supports of cast iron or threaded pipe not permitted.
- .2 Static equipment:
 - .1 Anchor equipment to equipment supports. Anchor equipment supports to structure.
 - .2 Suspended equipment:
 - .1 Use one or more of following methods depending upon site conditions and/or as indicated:
 - .1 Install tight to structure.
 - .2 Cross brace in every direction.
 - .3 Brace back to structure.
 - .4 Cable restraint system.
 - .3 Seismic restraints:
 - .1 Cushioning action gentle and steady.
 - .2 Never reach metal-like stiffness.
- .3 Vibration isolated equipment:
 - .1 Seismic control measures not to jeopardize noise and vibration isolation systems. Provide 6 to 9 mm clearance during normal operation of equipment and systems between seismic restraint and equipment.
 - .2 Incorporate seismic restraints into vibration isolation system to resist complete isolator unloading.
- .4 Piping systems:
 - .1 Fire protection systems: to NFPA 13
 - .2 Piping systems: hangers longer than 305 mm; brace at each hanger.
 - .3 Compatible with requirements for anchoring and guiding of piping systems.
- .5 Bracing methods:
 - .1 Approved by DCC Representative.
 - .2 Structural angles or channels.
 - .3 Cable restraint system incorporating grommets, shackles and other hardware to ensure alignment of restraints and to avoid bending of cables at connection points. Incorporate neoprene into cable connections to reduce shock loads.

Part 3 Execution

3.1 MANUFACTURER'S INSTRUCTIONS

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

3.2 INSTALLATION

- .1 Seismic control measures to meet requirements of NBC.
- .2 Install vibration isolation equipment in accordance with manufacturers instructions and adjust mountings to level equipment.
- .3 Ensure piping, ducting and electrical connections to isolated equipment do not reduce system flexibility and that piping, conduit and ducting passage through walls and floors do not transmit vibrations.
- .4 Unless indicated otherwise, support piping connected to isolated equipment with spring mounts or spring hangers with 25 mm minimum static deflection as follows:
 - .1 Up to NPS4: first 3 points of support. NPS5 to NPS8: first 4 points of support. NPS10 and Over: first 6 points of support.
 - .2 First point of support: static deflection of twice deflection of isolated equipment, but not more than 50 mm.
- .5 Where isolation is bolted to floor use vibration isolation rubber washers.
- .6 Block and shim level bases so that ductwork and piping connections can be made to rigid system at operating level, before isolator adjustment is made. Ensure that there is no physical contact between isolated equipment and building structure.

3.3 CLEANING

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

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 09 91 23 - Interior Painting

1.2 REFERENCE STANDARDS

- .1 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.
- .2 National Fire Protection Association (NFPA):
 - .1 NFPA 13-2022, Standard for the Installation of Sprinkler Systems.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

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

1.4 QUALITY ASSURANCE

- .1 Quality assurance submittals: submit following in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Health and Safety:
 - .1 Do construction occupational health and safety in accordance with Section 01 35 29.06 - Health and Safety Requirements.

1.5 DELIVERY, STORAGE, AND HANDLING

- .1 Packing, shipping, handling and unloading:
 - .1 Deliver, store and handle in accordance with Section 01 61 00 - Common Product Requirements.
 - .2 Deliver, store and handle materials in accordance with manufacturer's written instructions.
- .2 Waste Management and Disposal:
 - .1 Waste Management and Disposal: separate waste materials for reuse and recycling in accordance with Section 01 74 19 - Waste Management and Disposal.

- .2 Dispose of unused paint, coating material at official hazardous material collections site approved by DCC Representative.
- .3 Do not dispose of unused paint, coating material into sewer system, into streams, lakes, onto ground or in locations where it will pose health or environmental hazard.

Part 2 Products

2.1 MANUFACTURER'S EQUIPMENT NAMEPLATES

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

2.2 SYSTEM NAMEPLATES

- .1 Colours:
 - .1 Hazardous: red letters, white background.
 - .2 Elsewhere: black letters, white background (except where required otherwise by applicable codes).
- .2 Construction:
 - .1 3 mm thick laminated plastic, 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.
- .5 Identification for PSPC 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 DCC Representative.

2.4 PIPING SYSTEMS GOVERNED BY CODES

- .1 Identification:
 - .1 Sprinklers: to NFPA 13.

2.5 IDENTIFICATION OF PIPING SYSTEMS

- .1 Identify contents by background colour marking, pictogram (as necessary), legend; direction of flow by arrows. To CAN/CGSB 24.3 except where specified otherwise
- .2 Pictograms:
 - .1 Where required: Workplace Hazardous Materials Information System (WHMIS) regulations.
- .3 Legend:
 - .1 Block capitals to sizes and colours listed in CAN/CGSB 24.3
- .4 Arrows showing direction of flow:
 - .1 Outside diameter of pipe or insulation less than 75 mm: 100 mm long x 50 mm high.
 - .2 Outside diameter of pipe or insulation 75 mm and greater: 150 mm long x 50 mm high.
 - .3 Use double-headed arrows where flow is reversible.
- .5 Extent of background colour marking:
 - .1 To full circumference of pipe or insulation.
 - .2 Length to accommodate pictogram, full length of legend and arrows.
- .6 Materials for background colour marking, legend, arrows:
 - .1 Pipes and tubing 20 mm and smaller: waterproof and heat-resistant pressure sensitive plastic marker tags.

- .2 Other pipes: pressure sensitive vinyl with protective overcoating, waterproof contact adhesive undercoating, suitable for ambient of 100% RH and continuous operating temperature of 150°C and intermittent temperature of 200°C.

.7 Colours and Legends:

- .1 Where not listed, obtain direction from DCC Representative.
.2 Colours for legends, arrows: to following table:

<u>Background colour</u>	<u>Legend, arrows</u>
Yellow	BLACK
Green	WHITE
Red	WHITE

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

<u>Contents</u>	<u>Background colour marking</u>	<u>Legend</u>
Storm water	Green	STORM
Sanitary	Green	SAN
Plumbing vent	Green	SAN. VENT
Diesel suction	Yellow	DIESEL
Diesel return	Yellow	DIESEL
Engine exhaust	Yellow	ENGINE EXHAUST
Fire protection water	Red	FIRE PROT. WTR
Sprinklers	Red	SPRINKLERS

2.6 IDENTIFICATION DUCTWORK SYSTEMS

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

2.7 VALVES, CONTROLLERS

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

2.8 CONTROLS COMPONENTS IDENTIFICATION

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

2.9 LANGUAGE

- .1 Identification in English and French.

- .2 Use one nameplate and label for both languages.

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 TIMING

- .1 Provide identification only after painting specified Section 09 91 23 - Interior Painting has been completed.

3.3 INSTALLATION

- .1 Perform work in accordance with CAN/CGSB-24.3 except as specified otherwise.
- .2 Provide ULC and/or CSA registration plates as required by respective agency.
- .3 Identify systems, equipment to conform to PWGSC PMSS.

3.4 NAMEPLATES

- .1 Locations:
 - .1 In conspicuous location to facilitate easy reading and identification from operating floor.
- .2 Standoffs:
 - .1 Provide for nameplates on hot and/or insulated surfaces.
- .3 Protection:
 - .1 Do not paint, insulate or cover.

3.5 LOCATION OF IDENTIFICATION ON PIPING AND DUCTWORK SYSTEMS

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

- .7 At beginning and end points of each run and at each piece of equipment in run.
- .8 At point immediately upstream of major manually operated or automatically controlled valves, and dampers. Where this is not possible, place identification as close as possible, preferably on upstream side.
- .9 Identification easily and accurately readable from usual operating areas and from access points.
 - .1 Position of identification approximately at right angles to most convenient line of sight, considering operating positions, lighting conditions, risk of physical damage or injury and reduced visibility over time due to dust and dirt.

3.6 VALVES, CONTROLLERS

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

3.7 CLEANING

- .1 Proceed in accordance with Section 01 74 00 - Cleaning.

END OF SECTION

Part 1 General

1.1 SUMMARY

- .1 Testing, adjusting, and balancing of HVAC equipment to achieve specified performance requirements.

1.2 REFERENCE STANDARDS

- .1 American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE):
 - .1 ANSI/ASHRAE Standard 111-2008 (RA2017), Measurement, Testing, Adjusting, and Balancing of Building HVAC Systems.
- .2 Associated Air Balance Council (AABC):
 - .1 ANSI/AABC National Standards for Total System Balance, Seventh Edition, 2016.
- .3 National Environmental Balancing Bureau (NEBB):
 - .1 NEBB Procedural Standard for Testing, Adjusting, and Balancing of Environmental Systems, Ninth Edition, 2019.
- .4 Sheet Metal and Air Conditioning Contractors' National Association (SMACNA):
 - .1 SMACNA 1780-2002 - HVAC Systems - Testing, Adjusting and Balancing.

1.3 ADMINISTRATIVE REQUIREMENTS

- .1 Coordination:
 - .1 Test and balance each system independently and where interlocked with other systems, in unison with those systems.
- .2 Scheduling:
 - .1 Schedule time required for work of this Section (including repairs, and re-testing) into Project schedules to ensure completion before scheduled completion date.

1.4 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit proposed methodology and procedures for performing work of this Section.
- .2 Before starting work of this Section, submit names and documented qualifications of personnel to perform work of this Section.
- .3 Submit list of instruments and include serial numbers and calibration certificates.
- .4 Preliminary Report: Submit for checking and approval by DCC Representative before submission of formal report. Include:
 - .1 Details of instruments used.
 - .2 Details of procedures employed.
 - .3 Calculations procedures.

- .4 Summaries.
- .5 Testing and Balancing Report:
 - .1 Format in accordance with ANSI/AABC National Standards for Total System Balance, ANSI/ASHRAE 111, NEBB Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems, SMACNA 1780 and show results in SI units.
 - .2 Include:
 - .1 Project record drawings
 - .2 System schematics
 - .3 Submit one (1) electronic copy of the report to DCC Representative, in English, digital files, complete with index tabs.

1.5 QUALITY ASSURANCE

- .1 Regulatory Requirements: Test and balance systems regulated by codes to the satisfaction of the authority having jurisdiction.
- .2 Agency Qualifications: Company specializing in the testing, adjusting, and balancing of systems specified in this Section, certified by AABC or NEBB.
- .3 Where instrument manufacturer calibration recommendations are more stringent than those listed in TAB Standard, use manufacturer's recommendations.

Part 2 Products

2.1 NOT USED

- .1 Not used.

Part 3 Execution

3.1 PREPARATION

- .1 During construction, coordinate location and installation of measurement and balancing devices, equipment, accessories, measurement ports, and fittings.
- .2 Calibrate instruments in accordance with requirements of most stringent of referenced standard for either applicable system or HVAC system.
- .3 Calibrate instruments within three (3) months of work. Submit certificate of calibration.
- .4 Notify DCC Representative seven (7) days before start of work.

3.2 VERIFICATION OF CONDITIONS

- .1 Verify that building is substantially complete, including:
 - .1 Installation of ceilings, doors, windows, and other construction affecting the Work.

- .2 Application of weatherstripping, sealing, and sealants.
- .3 Pressure, leakage, and other tests specified elsewhere in Division 23.
- .4 Provisions for Work are installed and operational.
- .2 Verify proper, normal, and safe operation of mechanical and associated electrical and control systems affecting Work including but not limited to:
 - .1 Proper thermal overload protection in place for electrical equipment.
 - .2 Air systems:
 - .1 Filters in place are clean.
 - .2 Duct systems are clean.
 - .3 Ducts are airtight to within specified tolerances.
 - .4 Correct fan rotation.
 - .5 Volume control dampers are installed and open.
 - .6 Access doors are installed and closed.
 - .7 Outlets are installed and volume control dampers are open.
 - .3 Liquid systems:
 - .1 Flushed, filled, and vented.
 - .2 Correct pump rotation.
 - .3 Strainers are in place and baskets are clean.
 - .4 Isolating valves are installed and open.

3.3 SYSTEM START-UP

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

3.4 ADJUSTING

- .1 Operate systems as required to perform the work and as required by DCC Representative for verification of reports.
- .2 Test to verify proper and safe operation, to determine actual point of performance, and to evaluate qualitative and quantitative performance of equipment, systems and controls at design loads using actual or simulated loads.
- .3 Adjust and regulate equipment and systems to meet specified performance requirements and to achieve specified interaction with other related systems under normal operating conditions.
- .4 Balance systems and equipment to regulate flow rates to match load requirements over full operating ranges.

3.5 AIR SYSTEMS

- .1 Test and balance air systems to ANSI/AABC National Standards for Total System Balance, ANSI/ASHRAE 111, NEBB Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems, SMACNA 1780.
- .2 Take measurements as appropriate for application, including but not limited to air velocity, static pressure, flow rate, pressure drop (or loss), duct cross-sectional area, RPM, electrical power, voltage and noise.

3.6 TOLERANCES

- .1 HVAC systems: +5%, -5% of design.
- .2 Accuracy: +/-2% of actual values.

3.7 SITE QUALITY CONTROL

- .1 Reported results are subject to verification by DCC Representative. Verify number and location of results as directed by DCC Representative.
- .2 Provide personnel and instrumentation to verify up to 100% of reported results.
- .3 Repeat work as required until results fall within specified performance values.

3.8 CLOSEOUT ACTIVITIES

- .1 After work is completed to satisfaction of DCC 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.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 23 05 29 - Hangers and Supports for HVAC Piping and Equipment.
- .2 Section 23 31 13.01 Metal Ducts – Low Pressure to 500Pa.

1.2 REFERENCE STANDARDS

- .1 American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE)
 - .1 ANSI/ASHRAE/IESNA 90.1-2019, SI; Energy Standard for Buildings Except Low-Rise Residential Buildings.
- .2 ASTM International (ASTM)
 - .1 [ASTM B 209M-2021a](#), Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate (Metric).
 - .2 [ASTM C 335/C 335M-2017](#), Standard Test Method for Steady State Heat Transfer Properties of Pipe Insulation.
 - .3 [ASTM C 411-2019](#), Standard Test Method for Hot-Surface Performance of High-Temperature Thermal Insulation.
 - .4 [ASTM C 449-2007\(r2019\)](#), Standard Specification for Mineral Fiber-Hydraulic-Setting Thermal Insulating and Finishing Cement.
 - .5 [ASTM C 547-2019](#), Standard Specification for Mineral Fiber Pipe Insulation.
 - .6 [ASTM C 553-2013r2019](#), Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications.
 - .7 [ASTM C 612-2014r2019](#), Standard Specification for Mineral Fiber Block and Board Thermal Insulation.
 - .8 [ASTM C 795-2008r2018](#), Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel.
 - .9 [ASTM C 921-2010\(r2015\)](#), Standard Practice for Determining the Properties of Jacketing Materials for Thermal Insulation.
- .3 Canadian General Standards Board (CGSB)
 - .1 [CGSB 51-GP-52Ma-89](#), Vapour Barrier, Jacket and Facing Material for Pipe, Duct and Equipment Thermal Insulation.
- .4 Green Seal Environmental Standards (GSES)
 - .1 Standard GS-36-2013, Commercial Adhesives.
- .5 South Coast Air Quality Management District (SCAQMD), California State
 - .1 SCAQMD Rule 1168-A2017, Adhesive and Sealant Applications.
- .6 Thermal Insulation Association of Canada (TIAC): National Insulation Standards (2005).
- .7 Underwriters Laboratories of Canada (ULC)

- .1 CAN/ULC-S102-2018, Method of Test for Surface Burning Characteristics of Building Materials and Assemblies.
- .2 CAN/ULC-S701-2017, Standard for Thermal Insulation, Polystyrene, Boards and Pipe Covering.

1.3 DEFINITIONS

- .1 For purposes of this section:
 - .1 "CONCEALED" - insulated mechanical services and equipment in suspended ceilings and non-accessible chases and furred-in spaces.
 - .2 "EXPOSED" - means "not concealed" as previously defined.
 - .3 Insulation systems - insulation material, fasteners, jackets, and other accessories.
- .2 TIAC Codes:
 - .1 CRD: Code Round Ductwork,
 - .2 CRF: Code Rectangular Finish.

1.4 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Provide manufacturer's printed product literature and datasheets for duct insulation, and include product characteristics, performance criteria, physical size, finish and limitations.
 - .1 Description of equipment giving manufacturer's name, type, model, year and capacity.
 - .2 Details of operation, servicing and maintenance.
 - .3 Recommended spare parts list.
- .3 Shop Drawings:
 - .1 Submit drawings stamped and signed by professional engineer registered or licensed in the Province of Ontario, Canada.
- .4 Manufacturers' Instructions:
 - .1 Provide manufacture's written duct insulation jointing recommendations. and special handling criteria, installation sequence, cleaning procedures.

1.5 QUALITY ASSURANCE

- .1 Qualifications:
 - .1 Installer: specialist in performing work of this section and a member of TIAC.

1.6 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 and ULC markings.

- .3 Packaging Waste Management: remove for reuse and return by manufacturer of pallets, crates, padding and packaging materials in accordance with Section 01 74 19 Waste Management and Disposal.

Part 2 Products

2.1 FIRE AND SMOKE RATING

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

2.2 INSULATION

- .1 Mineral fibre: as specified includes glass fibre, rock wool, slag wool.
- .2 Thermal conductivity ("k" factor) not to exceed specified values at 24 degrees C mean temperature when tested in accordance with [ASTM C 335](#).
- .3 TIAC Code C-1: Rigid mineral fibre board to [ASTM C 612](#), with factory applied vapour retarder jacket to [CGSB 51-GP-52Ma](#) (as scheduled in PART 3 of this Section).
- .4 TIAC Code C-2: Mineral fibre blanket to [ASTM C 553](#) faced without factory applied vapour retarder jacket to [CGSB 51-GP-52Ma](#) (as scheduled in PART 3 of this section).
 - .1 Mineral fibre: to [ASTM C 553](#).
 - .2 Jacket: to [CGSB 51-GP-52Ma](#).
 - .3 Maximum "k" factor: to [ASTM C 553](#).

2.3 JACKETS

- .1 Aluminum:
 - .1 To [ASTM B 209](#) with moisture barrier as scheduled in PART 3 of this section.
 - .2 Thickness: 0.50 mm sheet.
 - .3 Finish: Stucco embossed.
 - .4 Jacket banding and mechanical seals: 12 mm wide, 0.5 mm thick stainless steel.
 - .1 Stainless steel:
 - .5 Type: 316.
 - .6 Thickness: 0.25 mm sheet.
 - .7 Finish: Stucco embossed.
 - .8 Jacket banding and mechanical seals: 12 mm wide, 0.5 mm thick stainless steel.

2.4 ACCESSORIES

- .1 Vapour retarder lap adhesive:
 - .1 Water based, fire retardant type, compatible with insulation.
- .2 Indoor Vapour Retarder Finish:

- .1 Vinyl emulsion type acrylic, compatible with insulation.
- .3 Insulating Cement: hydraulic setting on mineral wool, to [ASTM C 449](#).
- .4 Outdoor Vapour Retarder Mastic:
 - .1 Vinyl emulsion type acrylic, compatible with insulation.
 - .2 Reinforcing fabric: Fibrous glass, untreated 305 g/m².
- .5 Tape: self-adhesive, aluminum, reinforced, 50 mm wide minimum.
- .6 Contact adhesive: quick-setting
- .7 Tie wire: 1.5 mm stainless steel.
- .8 Banding: 12 mm wide, 0.5 mm thick stainless steel.
- .9 Facing: 25 mm stainless steel hexagonal wire mesh stitched on one face of insulation.
- .10 Fasteners: 4 mm diameter pins with 35 mm diameter clips, length to suit thickness of insulation.

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 PRE-INSTALLATION REQUIREMENTS

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

3.3 INSTALLATION

- .1 Install in accordance with TIAC National Standards.
- .2 Apply materials in accordance with manufacturer's instructions and as indicated.
- .3 Use 2 layers with staggered joints when required nominal thickness exceeds 75 mm.
- .4 Maintain uninterrupted continuity and integrity of vapour retarder jacket and finishes.
 - .1 Ensure hangers, and supports are outside vapour retarder jacket.
- .5 Hangers and supports in accordance with Section 23 05 29 - Hangers and Supports for HVAC Piping and Equipment.
 - .1 Apply high compressive strength insulation where insulation may be compressed by weight of ductwork.
- .6 Fasteners: install at 300 mm on centre in horizontal and vertical directions, minimum 2 rows each side.

3.4 DUCTWORK INSULATION SCHEDULE

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

	TIAC Code	Vapour Retarder	Thickness (mm)
Outside air ducts to <u>mixing plenum</u>	C-1	yes	25
<u>Mixing plenums</u>	C-1	yes	25
Exhaust duct between <u>dampers and louvres</u>	C-1	no	25

3.5 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 19 Waste Management and Disposal.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 23 05 15 – Common Installation Requirements for HVAC Pipework.
- .2 Section 23 05 23.01 - Valves - Bronze.

1.2 REFERENCE STANDARDS

- .1 American Society of Mechanical Engineers (ASME)
 - .1 ASME-B16.3-2021, Malleable-Iron Threaded Fittings: Classes 150 and 300.
 - .2 ASME-B16.9-2018, Factory-Made Wrought Steel Buttwelding Fittings.
- .2 ASTM International (ASTM)
 - .1 [ASTM A 47/A 47M-1999\(R2018\)e1](#), Standard Specification for Ferritic Malleable Iron Castings.
 - .2 [ASTM A 53/A 53M-2020](#), Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc Coated, Welded and Seamless.
- .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 CSA Group (CSA)
 - .1 [CSA-B139-2019](#), Installation Code for Oil Burning Equipment.
 - .2 [CSA-B140.0-2003\(R2018\)](#), Oil Burning Equipment: General Requirements.
 - .3 [CSA-C282-2019](#), Emergency Electrical Power Supply for Buildings.
- .5 Health Canada / Workplace Hazardous Materials Information System (WHMIS)
 - .1 Safety Data Sheets (SDS).
- .6 Manufacturers Standardization Society of the Valve and Fitting Industry (MSS)
 - .1 MSS-SP-80-2019, Bronze Gate, Globe, Angle and Check Valves.
- .7 National Association of Corrosion Engineers (NACE)
 - .1 NACE SP0169-2013, Control of External Corrosion on Underground or Submerged Metallic Piping Systems.
- .8 National Research Council Canada (NRC)
 - .1 National Fire Code of Canada 2015 (NFC).
- .9 South Coast Air Quality Management District (SCAQMD), California State, Regulation XI. Source Specific Standards
 - .1 SCAQMD Rule 1113-A2016, Architectural Coatings.
- .10 Underwriter's Laboratories of Canada (ULC)

- .1 CAN/ULC S603.1-2017, 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.

1.3 ADMINISTRATIVE REQUIREMENTS

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

1.4 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Provide manufacturer's printed product literature, 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.
 - .2 Provide two copies of WHMIS SDS in accordance with Section 01 35 29.06 - Health and Safety Requirements.
- .3 .3 Indicate VOC's for adhesive and solvents during application and curing.
- .4 .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.

1.5 CLOSEOUT SUBMITTALS

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

1.6 QUALITY ASSURANCE

- .1 Sustainability Standards Certification:
 - .1 Low-Emitting Materials: provide listing of adhesives and sealants and paints and coatings and carpet used in building, comply with VOC and chemical component limits or restriction requirements.

- .2 Ensure piping is installed by company authorized by authority having jurisdiction.

1.7 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements:
 - .1 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.
- .3 Packaging Waste Management: remove for reuse and return by manufacturer of pallets, crates, padding, and packaging materials in accordance with Section 01 74 19 Waste Management and Disposal.

Part 2 Products

2.1 FILL VENT AND CARRIER PIPE

- .1 Materials as per [CSA-B139](#), CEPA SOR/2008-197, NFC.
- .2 Steel: to [ASTM A 53/A 53M](#), Schedule 40, continuous weld or electric resistance welded, screwed.

2.2 STEEL PIPE COATING

- .1 Bituminous paint: in accordance with manufacturer's recommendations.
- .2 Primers, Paints, 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.
 - .2 Welding: butt-welding to ASME-B16.9.
 - .3 Unions: malleable iron, brass to iron, ground seat, screwed, to [ASTM A 47/A 47M](#).
 - .4 Nipples: Schedule 40, to [ASTM A 53/A 53M](#).

2.5 BALL VALVES

- .1 NPS 2 and under: bronze body, screwed ends, TFE seal, hard chrome ball, 4 MPa, WOG as specified under Section 23 05 23.01 - Valves - Bronze.

2.6 LUBRICATED PLUG COCKS

- .1 NPS 2 and under, screwed: to [ASTM B 61](#), Class 150, 1 MPa, bronze body.

2.7 OIL FILTER

- .1 Duplex type replaceable cartridge type as recommended by oil burner manufacturer.
- .2 Furnish spare filter cartridge.

2.8 CATHODIC PROTECTION

- .1 Supply cathodic protection in accordance with Section 26 42 00.01 - Telethermics - Cathodic Protection.

2.9 OIL TANKS

- .1 1890 L double wall steel above ground storage tank on steel legs. Tank complete with:
 - .1 Interstitial space leak monitoring
 - .2 Fill pipe, vent, level gauge, fuel return, fuel supply pipe fittings
 - .3 Level gauge

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 15 – Common Installation Requirements for HVAC Pipework, supplemented as specified.
- .2 Install oil piping system in accordance with NFC, [CSA-B139](#) and [CSA-B140.0](#).
- .3 Slope piping down in direction of storage tank unless otherwise indicated.
- .4 Underground piping to be protected in conformance with **CAN/ULC-S603.1**.
- .5 Above ground piping to be protected from physical impact due to impact.
- .6 Piping inside building:
 - .1 Ensure piping in solid flooring is installed to [CSA-B139](#).
 - .2 Use approved fitting to [CSA-B139](#) for steel piping.
 - .3 Install filter, gate valve, and fire valve at burners.
- .7 Fill, vent, suction and return piping outside building:
 - .1 Steel piping welded throughout except at tanks where electrically isolating fittings are used.
 - .2 Grading: slope piping at 1% minimum back to tanks.
- .8 Install buried piping in double-wall piping to [CSA-B139](#).

- .9 Piping at tanks:
 - .1 Suction: terminate 150 mm from bottom of tank with foot valve and strainer.
 - .2 Return: terminate 150 mm from bottom of tank with return bend.
 - .3 Comply with [CSA-B139](#) for piping for venting at tanks including venting whistle.
 - .4 Fill pipes: install to comply with [CSA-B139](#).
 - .1 Include vapour tight tamperproof cover.
 - .2 Equip fill pipes on tanks with capacity greater than 5000 L with liquid and vapour tight connections.
 - .5 Dipstick: extend tube to within 150 mm from bottom of tank. Terminate at grade with lockable cap and chain, and watertight cover.
- .10 Clearly label piping runs in legible form indicating:
 - .1 Piping product content.
 - .2 Direction of flow.
 - .3 Identify transfer points in piping systems to CPPI Colour-Symbol System to Mark Equipment and Vehicles for Product Identification

3.3 VALVES

- .1 Install valves with stems upright or horizontal unless approved otherwise by DCC Representative.
- .2 Install ball valves at branch take-offs, to isolate pieces of equipment and as indicated.
- .3 Install plug cocks as indicated.

3.4 OIL FILTERS

- .1 Install ULC approved as indicated in supply line to.
- .2 At time of acceptance, replace filter cartridge with new.

3.5 OVERFILL AND SPILL PROTECTION

- .1 To [CSA-B139](#).

3.6 LEAK DETECTION

- .1 Install line leak detector to ULC ORD C107.12.
- .2 Install secondary containment systems that will allow leaks to accumulate in containment sump available for visual inspection.

3.7 CATHODIC PROTECTION SYSTEM

- .1 Install in accordance with Section 26 42 00.01 - Telethermics - Cathodic Protection.
- .2 Cathodic protection to CEPA.
- .3 Use electric isolating type fittings and electric isolating components for tank manhole covers supplied with fuel oil storage tanks to isolate piping from tanks.

- .4 Isolate buried piping into separate sections as indicated.
- .5 Isolate buried piping systems from remainder of system inside building.
- .6 Coat buried steel outer casing piping, before installation, with electrically resistant coating highly resistant to mechanical damage.
 - .1 Ensure 100% coverage.
 - .2 Repeat after installation at joints and damaged parts only.
- .7 Inspect buried steel outer casing piping and repair damaged coatings using same materials as original coatings.

3.8 FIELD QUALITY CONTROL

- .1 Site Tests/Inspection:
 - .1 Test system to [CSA-B139](#) and [CSA-B140.0](#) and authorities having jurisdiction.
 - .2 Isolate tanks from piping pressure tests.
 - .3 Maintain test pressure during backfilling.
- .2 Manufacturer's Field Services:
 - .1 Have manufacturer of products, supplying materials for Work of this Section, review Work involved in handling, installation/application, protection and cleaning, of its products and submit written reports, in acceptable format, to verify compliance of Work with Contract.
 - .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, at stages listed:
 - .1 After delivery and storage of products, and when preparatory Work, or other Work, on which the Work of this Section depends, is complete but before installation begins.
 - .2 Twice during progress of Work at 25 % and 60 % complete.
 - .3 Upon completion of the Work, after cleaning is carried out.
 - .4 Obtain reports, within 3 days of review, and submit, immediately, to DCC Representative.

3.9 CLEANING

- .1 Clean in accordance with Section 01 74 11 – Cleaning, and manufacturer's written recommendations, supplemented as follows:
 - .1 Flush after pressure test with 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.
- .2 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 19 Waste Management and Disposal.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 23 05 29 - Hangers and Supports for HVAC Piping and Equipment.

1.2 REFERENCE STANDARDS

- .1 American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE)
- .2 ASTM International (ASTM)
 - .1 [ASTM A 480/A 480M-2020a](#), Standard Specification for General Requirements for Flat-Rolled Stainless and Heat-Resisting Steel Plate, Sheet and Strip.
 - .2 [ASTM A 635/A 635M-2015](#), Standard Specification for Steel, Sheet and Strip, Heavy-Thickness Coils, Hot-Rolled, Alloy, Carbon, Structural, High-Strength Low-Alloy, and High-Strength Low-Alloy with Improved Formability, General Requirements for.
 - .3 [ASTM A 653/A 653M-2020](#), Standard Specification for Steel Sheet, Zinc Coated (Galvanized) or Zinc-Iron Alloy Coated (Galvannealed) by the Hot-Dip Process.
- .3 Green Seal Environmental Standards (GS)
 - .1 GS-36-2013, Standard for Adhesives for Commercial Use.
- .4 National Fire Protection Association (NFPA)
 - .1 [NFPA 90A-2021](#), Standard for the Installation of Air-Conditioning and Ventilating Systems.
 - .2 [NFPA 90B-2021](#), Standard for the Installation of Warm Air Heating and Air-Conditioning Systems.
 - .3 [NFPA 96-2021](#), Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations.
- .5 Sheet Metal and Air Conditioning Contractors' National Association (SMACNA)
 - .1 SMACNA HVAC Duct Construction Standards - Metal and Flexible, 2005.
 - .2 SMACNA HVAC Air Duct Leakage Test Manual, 2012.
 - .3 IAQ Guideline for Occupied Buildings Under Construction 2007.
- .6 South Coast Air Quality Management District (SCAQMD), California State, Regulation XI. Source Specific Standards
 - .1 SCAQMD Rule 1168-A2017, Adhesives and Sealants Applications.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

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

- .3 Shop Drawings:
 - .1 Submit drawings stamped and signed by professional engineer registered or licensed in Province of Ontario, Canada.
- .4 Test and Evaluation Reports:
 - .1 Certification of Ratings:
 - .1 Catalogue or published ratings to be those obtained from tests carried out by manufacturer or independent testing agency signifying adherence to codes and standards.

1.4 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store materials in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect metal ducts from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.
- .4 Packaging Waste Management: remove for reuse and return by manufacturer of pallets, crates, padding, and packaging materials in accordance with Section 01 74 19 Waste Management and Disposal.

Part 2 Products

2.1 SEAL CLASSIFICATION

- .1 Classification as follows:

Maximum Pressure Pa	SMACNA Seal Class
500	C
250	C
125	C
125	Unsealed

- .2 Seal classification:
 - .1 Class A: longitudinal seams, transverse joints, duct wall penetrations and connections made airtight with sealant and tape.
 - .2 Class B: longitudinal seams, transverse joints and connections made airtight with sealant.
 - .3 Class C: transverse joints and connections made air tight with gaskets or sealant. Longitudinal seams unsealed.
 - .4 Unsealed seams and joints.

2.2 SEALANT

- .1 Sealant: oil resistant, water borne, polymer type flame resistant duct sealant. Temperature range of minus 30 degrees C to plus 93 degrees C.

2.3 TAPE

- .1 Tape: polyvinyl treated, open weave fiberglass tape, 50 mm wide.

2.4 DUCT LEAKAGE

- .1 In accordance with SMACNA HVAC Air Duct Leakage Test Manual.

2.5 FITTINGS

- .1 Fabrication: to SMACNA.
- .2 Radiused elbows:
 - .1 Rectangular: standard radius centreline radius: 1.5 times width of duct.
 - .2 Round: smooth radius, centreline radius: 1.5 times diameter.
- .3 Mitred elbows, rectangular:
 - .1 To 407 mm: with single thickness turning vanes.
 - .2 Over 407 mm: with double thickness turning vanes.
- .4 Branches:
 - .1 Rectangular main and branch: with radius on branch 1.5 times width of duct.
 - .2 Round main and branch: enter main duct at 45 degrees with conical connection.
 - .3 Provide volume control damper in branch duct near connection to main duct.
 - .4 Main duct branches: with splitter damper.
- .5 Transitions:
 - .1 Diverging: 20 degrees maximum included angle.
 - .2 Converging: 30 degrees maximum included angle.
- .6 Offsets:
 - .1 Full radiused elbows.
- .7 Obstruction deflectors: maintain full cross-sectional area.
 - .1 Maximum included angles: as for transitions.

2.6 GALVANIZED STEEL

- .1 Lock forming quality: to [ASTM A 653/A 653M](#), Z90 zinc coating.
- .2 Thickness, fabrication and reinforcement: to SMACNA.
- .3 Joints: to SMACNA. Proprietary manufactured flanged duct joint to be considered to be a class A seal.

2.7 HANGERS AND SUPPORTS

.1 Hangers and Supports:

.1 Strap hangers: of same material as duct but next sheet metal thickness heavier than duct.

.1 Maximum size duct supported by strap hanger: 500.

.2 Hanger configuration: to SMACNA.

.3 Hangers: galvanized steel angle with galvanized steel rods to following table:

<u>Duct Size</u>	<u>Angle Size</u>	<u>Rod Size</u>
(mm)	(mm)	(mm)
up to 750	25 x 25 x 3	6
751 to 1050	40 x 40 x 3	6
1051 to 1500	40 x 40 x 3	10
1501 to 2100	50 x 50 x 3	10
2101 to 2400	50 x 50 x 5	10
2401 and over	50 x 50 x 6	10

.4 Upper hanger attachments:

.1 For concrete: manufactured concrete inserts.

.2 For steel joist: manufactured joist clamp.

.3 For steel beams: manufactured beam clamps:

Part 3 Execution

3.1 EXAMINATION

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

.1 Visually inspect substrate in presence of DCC Representative.

.2 Inform DCC Representative of unacceptable conditions immediately upon discovery.

.3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from DCC Representative.

3.2 GENERAL

.1 Do work in accordance with SMACNA and as indicated.

.2 Do not break continuity of insulation vapour barrier with hangers or rods.

.1 Insulate strap hangers 100 mm beyond insulated duct.

.3 Support risers in accordance with SMACNA.

.4 Install breakaway joints in ductwork on sides of fire separation.

.5 Install proprietary manufactured flanged duct joints in accordance with manufacturer's instructions.

.6 Manufacture duct in lengths and diameter to accommodate installation of acoustic duct lining.

3.3 HANGERS

- .1 Strap hangers: install in accordance with SMACNA.
- .2 Angle hangers: complete with locking nuts and washers.
- .3 Hanger spacing: in accordance with SMACNA as follows:

<u>Duct Size</u>	<u>Spacing</u>
(mm)	(mm)
to 1500	3000
<u>1501 and over</u>	<u>2500</u>

3.4 WATERTIGHT DUCT

- .1 Provide watertight duct for:
 - .1 Fresh air intake.
 - .2 As indicated.
- .2 Form bottom of horizontal duct without longitudinal seams.
 - .1 Weld joints of bottom and side sheets.
 - .2 Seal other joints with duct sealer.
- .3 Fit base of riser with 150 mm deep drain sump and 32 mm drain connected, with deep seal trap and trap primer and discharging to open funnel drain as indicated.

3.5 SEALING AND TAPING

- .1 Apply sealant in accordance with SMACNA and to manufacturer's recommendations.
- .2 Bed tape in sealant and recoat with minimum of 1 coat of sealant to manufacturers recommendations.

3.6 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.
 - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.
- .3 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 19 Waste Management and Disposal.
 - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 23 33 15 – Dampers – Operating.

1.2 REFERENCE STANDARDS

- .1 Sheet Metal and Air Conditioning Contractors' National Association (SMACNA)
 - .1 SMACNA - HVAC Duct Construction Standards - Metal and Flexible, 2020.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for air duct accessories and include product characteristics, performance criteria, physical size, finish and limitations.
 - .2 Indicate:
 - .1 Flexible connections.
 - .2 Duct access doors.
 - .3 Turning vanes.
 - .4 Instrument test ports.

1.4 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store materials in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect air duct accessories from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.
- .4 Develop Construction Waste Management Plan.
- .5 Packaging Waste Management: remove for reuse and return by manufacturer of pallets, crates, padding, and packaging materials as specified in Construction Waste Management Plan Waste Reduction Workplan in accordance with Section 01 74 19 Waste Management and Disposal.

Part 2 Products

2.1 GENERAL

- .1 Manufacture in accordance with SMACNA - HVAC Duct Construction Standards.

2.2 FLEXIBLE CONNECTIONS

- .1 Frame: galvanized sheet metal frame 2 mm thick with fabric clenched by means of double locked seams.
- .2 Material:
 - .1 Fire resistant, self extinguishing, neoprene coated glass fabric, temperature rated at minus 40 degrees C to plus 90 degrees C, density of 1.3 kg/m².

2.3 ACCESS DOORS IN DUCTS

- .1 Non-Insulated Ducts: sandwich construction of same material as duct, one sheet metal thickness heavier, minimum 0.6 mm thick complete with sheet metal angle frame.
- .2 Insulated Ducts: sandwich construction of same material as duct, one sheet metal thickness heavier, minimum 0.6 mm thick complete with sheet metal angle frame and 25 mm thick rigid glass fibre insulation.
- .3 Gaskets: neoprene.
- .4 Hardware:
 - .1 Up to 300 x 300 mm: two sash locks complete with safety chain.
 - .2 301 to 450 mm: four sash locks complete with safety chain.
 - .3 451 to 1000 mm: piano hinge and minimum two sash locks.
 - .4 Doors over 1000 mm: piano hinge and two handles operable from both sides.
 - .5 Hold open devices.
 - .6 300 x 300 mm glass viewing panels.

2.4 TURNING VANES

- .1 Factory or shop fabricated double thickness with trailing edge, to recommendations of SMACNA and as indicated.

2.5 INSTRUMENT TEST

- .1 1.6 mm thick steel zinc plated after manufacture.
- .2 Cam lock handles with neoprene expansion plug and handle chain.
- .3 28 mm minimum inside diameter. Length to suit insulation thickness.
- .4 Neoprene mounting gasket.

Part 3 Execution

3.1 EXAMINATION

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

3.2 INSTALLATION

- .1 Flexible Connections:
 - .1 Install in following locations:
 - .1 Inlets and outlets to supply air units and fans.
 - .2 Inlets and outlets of exhaust and return air fans.
 - .3 As indicated.
 - .2 Length of connection: 100 mm.
 - .3 Minimum distance between metal parts when system in operation: 75 mm.
 - .4 Install in accordance with recommendations of SMACNA.
 - .5 When fan is running:
 - .1 Ducting on sides of flexible connection to be in alignment.
 - .2 Ensure slack material in flexible connection.
- .2 Access Doors and Viewing Panels:
 - .1 Size:
 - .1 1000 x 2000 mm for person size entry.
 - .2 600 x 600 mm for servicing entry.
 - .3 300 x 300 mm for viewing.
 - .4 As indicated.
 - .2 Locations:
 - .1 Fire and smoke dampers.
 - .2 Control dampers.
 - .3 Devices requiring maintenance.
 - .4 Required by code.
 - .5 Reheat coils.
 - .6 Elsewhere as indicated.
- .3 Instrument Test Ports:
 - .1 General:
 - .1 Install in accordance with recommendations of SMACNA and in accordance with manufacturer's instructions.
 - .2 Locate to permit easy manipulation of instruments.

.3 Install insulation port extensions as required.

.4 Locations:

.1 For traverse readings:

.1 Ducted inlets to roof and wall exhausters.

.2 Inlets and outlets of other fan systems.

.3 Main and sub-main ducts.

.4 And as indicated.

.2 For temperature readings:

.1 At outside air intakes.

.2 In mixed air applications in locations as approved by DCC Representative.

.3 At inlet and outlet of coils.

.4 Downstream of junctions of two converging air streams of different temperatures.

.5 And as indicated.

.4 Turning Vanes:

.1 Install in accordance with recommendations of SMACNA and as indicated.

3.3 **CLEANING**

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

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

.2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.

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

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

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 23 33 00 - Air Duct Accessories.

1.2 REFERENCE STANDARDS

- .1 ASTM International (ASTM)
 - .1 [ASTM A 653/A 653M-2020](#), Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by Hot-Dip Process.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

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

1.4 CLOSEOUT SUBMITTALS

- .1 Submit in accordance with Section 01 78 00 - Closeout Submittals.
- .2 Operation and Maintenance Data: submit operation and maintenance data for dampers for incorporation into manual.

1.5 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store materials in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect dampers from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.
- .4 Packaging Waste Management: remove for reuse and return by manufacturer of pallets, crates, padding, and packaging materials in accordance with Section 01 74 19 Waste Management and Disposal.

Part 2 Products

2.1 MULTI-LEAF DAMPERS

- .1 Opposed blade type.
- .2 Extruded aluminum, interlocking blades, complete with extruded vinyl seals, spring stainless steel side seals, extruded aluminum frame.
- .3 Pressure fit self-lubricated bronze bearings.
- .4 Linkage: plated steel tie rods, brass pivots and plated steel brackets, complete with plated steel control rod.
- .5 Operator: electric.
- .6 Performance:
 - .1 Leakage: in closed position less than 2% of rated air flow at 249 Pa differential across damper.
 - .2 Pressure drop: at full open position less than 25 Pa differential across damper at 2.54 m/s.
- .7 Insulated aluminum dampers:
 - .1 Frames: insulated with extruded polystyrene foam with RSI 0.88.
 - .2 Blades: constructed from aluminum extrusions with internal hollows insulated with polyurethane or polystyrene foam, RSI 0.88.

2.2 BACK DRAFT DAMPERS

- .1 Automatic gravity operated, multi leaf, aluminum construction with nylon bearings, centre pivoted counterweighted.

2.3 RELIEF DAMPERS

- .1 Automatic multi-leaf aluminum dampers with ball bearing centre pivoted and counter-weights set to open at adjustable static pressure.

Part 3 Execution

3.1 EXAMINATION

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

3.2 INSTALLATION

- .1 Install where indicated.

- .2 Install in accordance with recommendations of SMACNA and manufacturer's instructions.
- .3 Seal multiple damper modules with silicon sealant.
- .4 Install access door adjacent to each damper. See Section 23 33 00 - Air Duct Accessories.
- .5 Ensure dampers are observable and accessible.

3.3 **CLEANING**

- .1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.
 - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.
- .3 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 19 Waste Management and Disposal.
 - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

END OF SECTION

Part 1 General

1.1 REFERENCE STANDARDS

- .1 American National Standards Institute/Air Movement and Control Association (ANSI/AMCA)
 - .1 ANSI/AMCA Standard 99-2016, Standards Handbook.
 - .2 ANSI/ASHRAE 51-2016 (Â ANSI/AMCA 210-2016), Laboratory Methods of Testing Fans for Aerodynamic Performance Rating.
 - .3 ANSI/AMCA Standard 300-2014, Reverberant Room Method for Sound Testing of Fans.
 - .4 ANSI/AMCA Standard 301-2014, Methods for Calculating Fan Sound Ratings from Laboratory Test Data.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for roof and wall exhausters and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Shop Drawings:
 - .1 Submit drawings stamped and signed by professional engineer registered or licensed in Province of Ontario, Canada.
 - .2 Include:
 - .1 Fan performance curves showing specified point of operation.
 - .2 Sound rating data.

1.3 MAINTENANCE MATERIAL SUBMITTALS

- .1 Extra Materials:
 - .1 Submit in accordance with Section 01 78 00 - Closeout Submittals.
 - .1 Furnish list of individual manufacturer's recommended spare parts for equipment, include:
 - .1 Bearings and seals.
 - .2 Addresses of suppliers.
 - .3 List of specialized tools necessary for adjusting, repairing or replacing.

1.4 DELIVERY, STORAGE AND HANDLING

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

- .1 Store materials in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
- .2 Store and protect roof and wall exhausters from nicks, scratches, and blemishes.
- .3 Replace defective or damaged materials with new.
- .4 Packaging Waste Management: remove for reuse and return by manufacturer of pallets, crates, padding, and packaging materials in accordance with Section 01 74 19 Waste Management and Disposal.

Part 2 Products

2.1 SYSTEM DESCRIPTION

- .1 Performance Requirements:
 - .1 Catalogued or published ratings for manufactured items: obtained from tests carried out by manufacturer or those ordered by manufacturer from independent testing agency signifying adherence to codes and standards in force. Provide confirmation of testing.
 - .2 Capacity: flow rate, total static pressure Pa, r/min, bhp, W, model and size and sound ratings, as indicated on schedule.
- .2 Statically and dynamically balanced. Constructed to ANSI/AMCA Standard 99.
- .3 Sound ratings: comply with ANSI/AMCA Standard 301, tested to ANSI/AMCA Standard 300. Unit shall bear AMCA certified sound rating seal.
- .4 Performance ratings: based on tests performed in accordance with ANSI/AMCA Standard 210, unit to bear AMCA certified rating seal.
- .5 Bearings: sealed lifetime ball bearings of self aligning type with oil retaining, dust excluding seals and a certified minimum rated life of 80,000 hours.

2.2 ROOF/WALL EXHAUSTERS

- .1 Centrifugal direct driven.
 - .1 Housings: spun aluminum complete with resilient mounted motor and fan.
 - .2 Impeller: aluminum non-overloading.
 - .3 12 mm mesh 2.0 mm diameter aluminum birdscreen.
 - .4 Automatic gasketed aluminum backdraft dampers.
 - .5 Disconnect switch within fan housing.
 - .6 Continuous curb gaskets, stainless steel securing bolts and screws.

Part 3 Execution

3.1 EXAMINATION

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

- .1 Visually inspect substrate in presence of DCC Representative.
- .2 Inform DCC Representative of unacceptable conditions immediately upon discovery.
- .3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from DCC Representative.

3.2 INSTALLATION

- .1 .1 Install in accordance with manufacturer's instructions.

3.3 ANCHOR BOLTS AND TEMPLATES

- .1 .1 Size anchor bolts to withstand seismic acceleration and velocity forces.

3.4 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.
 - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.
- .3 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 19 Waste Management and Disposal.
 - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 21 30 00 – Fire Pumps.

1.2 REFERENCE STANDARDS

- .1 American Conference of Governmental Industrial Hygienists (ACGIH)
 - .1 ACGIH 2095, Industrial Ventilation: A Manual of Recommended Practice for Design, 30th Edition.
- .2 ASTM International (ASTM)
 - .1 [ASTM C 700-2018](#), Standard Specification for Vitrified Clay Pipe, Extra Strength, Standard Strength and Perforated.
- .3 National Fire Protection Association (NFPA)
 - .1 [NFPA 91-2020](#), Standard for Exhaust Systems for Air Conveying of Vapors, Gases, Mists, and Noncombustible Particulate Solids.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for inlets, hoses, ducts, and fans and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Shop Drawings:
 - .1 Submit drawings stamped and signed by professional engineer registered or licensed in Province of Ontario, Canada.
 - .2 Indicate following:
 - .1 Methods of sealing sections.
 - .2 Methods of expansion.
 - .3 Details of thimbles.
 - .4 Bases/Foundations.
 - .5 Supports.
 - .6 Guy details.
 - .7 Rain caps.

1.4 MAINTENANCE MATERIAL SUBMITTALS

- .1 Extra Materials:
 - .1 Submit in accordance with Section 01 78 00 - Closeout Submittals.

- .2 Submit list of manufacturer's recommended spare parts for equipment such as bearings and seals, and addresses of suppliers, together with list of specialized tools necessary for adjusting, repairing or replacing, for placement into operating manual.

1.5 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store materials in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect exhaust systems from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.
- .4 Packaging Waste Management: remove for reuse and return by manufacturer of pallets, crates, padding, and packaging materials in accordance with Section 01 74 19 Waste Management and Disposal.

Part 2 Products

2.1 DUCTS

- .1 Above floor: schedule 40 304 stainless steel with welded joints. Shop fabricated, with sweep bends from engine outlet to thimble or chimney as indicated.

2.2 ACCESSORIES

- .1 Cleanouts: bolted, gasketed type, full size of breeching, as indicated.
- .2 Barometric dampers: single acting, 70% of full size of breeching area.
- .3 Hangers and supports: in accordance with recommendations SMACNA.
- .4 Rain cap.
- .5 Expansion sleeves with heat resistant caulking, held in place.
- .6 Silencer.

Part 3 Execution

3.1 EXAMINATION

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

- .1 Visually inspect substrate in presence of DCC Representative.
- .2 Inform DCC Representative of unacceptable conditions immediately upon discovery.
- .3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from DCC Representative.

3.2 INSTALLATION

- .1 Install in accordance with [NFPA 91](#), and to manufacturer's instructions.
- .2 Follow ACGIH industrial ventilation details, print VS-908.
- .3 Slope ducting to low point.
- .4 Install drain from low point in overhead ducts to floor drain.
- .5 Make joints watertight and airtight when subjected to 1.5 kPa pressure.
- .6 Install duct supports to manufacturer's recommendations.
- .7 Provide for thermal expansion with stainless steel bellows joint.
- .8 Provide thimble at building envelope penetration complete with flashing.
- .9 Terminate exhaust with rain cap.

3.3 TESTING

- .1 Test assembled and sealed ductwork from fan inlet to suction inlets under 2.5 kPa pressure for 30 minutes.
 - .1 Leakage not to exceed 1% of design total air flow.
- .2 Test apparatus to include calibrated orifice and manometer.

3.4 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.
 - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.
- .3 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 19 Waste Management and Disposal.
 - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

END OF SECTION

Part 1 General

1.1 REFERENCE STANDARDS

- .1 ASTM International (ASTM)
 - .1 [ASTM E 90-2009\(R2016\)](#), Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements.
- .2 National Fire Protection Association (NFPA)
 - .1 [NFPA 96-2021](#), Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations.
- .3 National Research Council Canada (NRC)
 - .1 National Building Code of Canada 2015 (NBC).
- .4 Sheet Metal and Air Conditioning Contractors' National Association (SMACNA)
- .5 Society of Automotive Engineers (SAE)

1.2 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for louvers, intakes and vents and include product characteristics, performance criteria, physical size, finish and limitations.
 - .2 Indicate following:
 - .1 Pressure drop.
 - .2 Face area.
 - .3 Free area.
- .3 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
- .4 Test Reports: submit certified data from independent laboratory substantiating acoustic and aerodynamic performance to [ASTM E 90](#).

1.3 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store materials in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.

- .2 Store and protect louvers, intakes and vents from nicks, scratches, and blemishes.
- .3 Replace defective or damaged materials with new.
- .4 Packaging Waste Management: remove for reuse and return by manufacturer of pallets, crates, padding, and packaging materials in accordance with Section 01 74 19 Waste Management and Disposal.

Part 2 Products

2.1 SYSTEM DESCRIPTION

- .1 Performance Requirements:
 - .1 Catalogued or published ratings for manufactured items: obtained from tests carried out by manufacturer or those ordered by manufacturer from independent testing agency signifying adherence to codes and standards.

2.2 FIXED LOUVRES - ALUMINUM

- .1 Construction: welded with exposed joints ground flush and smooth.
- .2 Material: extruded aluminum alloy 6063-T5.
- .3 Blade: stormproof pattern with centre watershed in blade, reinforcing bosses and maximum blade length of 1500 mm.
- .4 Frame, head, sill and jamb: 100 mm deep one piece extruded aluminum, minimum 3 mm thick with approved caulking slot, integral to unit.
- .5 Mullions: at 1500 mm maximum centres.
- .6 Fastenings: stainless steel SAE-194-8F with SAE-194-SFB nuts and resilient neoprene washers between aluminum and head of bolt, or between nut, ss washer and aluminum body.
- .7 Screen: 12 mm exhaust, 19 mm intake mesh, 2 mm diameter wire aluminum birdscreen on inside face of louvres in formed U-frame.
- .8 Finish: anodized. Colour: to DCC Representative's approval.

Part 3 Execution

3.1 EXAMINATION

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for louvres, intakes and vents installation in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate in presence of DCC Representative.
 - .2 Inform DCC Representative of unacceptable conditions immediately upon discovery.
 - .3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from DCC Representative.

3.2 INSTALLATION

- .1 In accordance with manufacturer's and SMACNA recommendations.
- .2 Reinforce and brace as indicated.
- .3 Anchor securely into opening. Seal with caulking to ensure weather tightness.

3.3 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.
 - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.
- .3 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 19 Waste Management and Disposal.
 - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

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

1.2 REFERENCE STANDARDS

- .1 CSA Group (CSA)
 - .1 [CSA C22.2 No.46-2013\(R2018\)](#), Electric Air-Heaters.
- .2 National Electrical Manufacturers Association (NEMA)
 - .1 NEMA 250-2020, Enclosures for Electrical Equipment (1000 V Maximum).

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for unit heaters and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Manufacturer's Instructions: provide to indicate special handling criteria, installation sequence, cleaning procedures.

1.4 CLOSEOUT SUBMITTALS

- .1 Submit in accordance with Section 01 78 00 - Closeout Submittals.
- .2 Operation and Maintenance Data: submit operation and maintenance data for unit heaters for incorporation into manual.

1.5 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store materials in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect unit heaters from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.
- .4 Packaging Waste Management: remove for reuse and return by manufacturer of pallets, crates, padding, and packaging materials in accordance with Section 01 74 19 Waste Management and Disposal.

Part 2 Products

2.1 UNIT HEATERS

- .1 Unit heater: to [CSA C22.2 No.46](#), horizontal discharge complete with adjustable louvers finished to match cabinet.
- .2 Fan type unit heaters with built-in high-heat limit protection, .
- .3 Fan motor: totally enclosed, permanently lubricated ball bearing.
 - .1 Built-in fan motor thermal overload protection.
- .4 Hangers: as recommended by manufacturer.
- .5 Elements: mineral insulated steel sheath with aluminum, brazed fins.
- .6 Cabinet: 18 gauge die-formed steel, fitted with brackets for rod or wall mounting.
 - .1 Phosphatized and finished with baked enamel.

2.2 CONTROLS

- .1 Wall mounted thermostats: type low voltage, Energy Star certified.

Part 3 Execution

3.1 EXAMINATION

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

3.2 INSTALLATION

- .1 Suspend unit heaters from ceiling or mount on wall as indicated.
- .2 Install thermostats in locations indicated.
- .3 Make power and control connections.

3.3 FIELD QUALITY CONTROL

- .1 Perform tests in accordance with Section 26 05 00 - Common Work Results for Electrical.
- .2 Test cut-out protection when air movement is obstructed.
- .3 Test fan delay switch to assure dissipation of heat after element shut down.

- .4 Test unit cut-off when fan motor overload protection has operated.
- .5 Ensure heaters and controls operate correctly.

3.4 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.
 - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.
- .3 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 19 Waste Management and Disposal.
 - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

3.5 PROTECTION

- .1 Protect installed products and components from damage during construction.
- .2 Repair damage to adjacent materials caused by unit heaters installation.

END OF SECTION

Part 1 General

1.1 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for liquid heaters and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.

1.2 DELIVERY, STORAGE, AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements.
- .2 Storage and Handling Requirements:
 - .1 Store materials indoors and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect liquid heaters from nicks, scratches, and blemishes.
- .3 Packaging Waste Management: remove for reuse and return of pallets, crates, padding, and packaging materials in accordance with Section 01 74 19 - Waste Management and Disposal.

Part 2 Products

2.1 LIQUID HEATERS

- .1 General: Over-the-side type electric immersion heater with flanged connection. Element to extend to bottom of tank. Moisture-resistant control box. Built-in thermostat.
- .2 Standard size 1-inch conduit openings
- .3 Sheath materials:
 - .1 Titanium
- .4 7500W, 600V, 3 phase.
- .5 CSA and UL approved

Part 3 Execution

3.1 EXAMINATION

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

3.2 INSTALLATION

- .1 Coordinate installation with Division 26. Wire to heater from junction box in flexible conduit.
- .2 Cut receptacle hole diameter in accordance with manufacturer's recommendations. Employ gasket, locknut and washer.

3.3 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 00 - Cleaning.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 00 - Cleaning.
- .3 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 19 - Waste Management and Disposal.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 25 05 01 - EMCS: General Requirements

1.2 DEFINITIONS

- .1 For additional acronyms and definitions refer to Section 25 05 01 - EMCS: General Requirements.
- .2 AEL: ratio between total test period less any system downtime accumulated within that period and test period.
- .3 Downtime: results whenever EMCS is unable to fulfill required functions due to malfunction of equipment defined under responsibility of EMCS contractor. Downtime is measured by duration, in time, between time that Contractor is notified of failure and time system is restored to proper operating condition. Downtime not to include following:
 - .1 Outage of main power supply in excess of back-up power sources, provided that:
 - .1 Automatic initiation of back-up was accomplished.
 - .2 Automatic shut-down and re-start of components was as specified.
 - .2 Failure of communications link, provided that:
 - .1 Controller automatically and correctly operated in stand-alone mode.
 - .2 Failure was not due to failure of any specified EMCS equipment.
 - .3 Functional failure resulting from individual sensor inputs or output devices, provided that:
 - .1 System recorded said fault.
 - .2 Equipment defaulted to fail-safe mode.
 - .3 AEL of total of all input sensors and output devices is at least 99% during test period.

1.3 DESIGN REQUIREMENTS

- .1 Confirm with DCC Representative that Design Criteria and Design Intents are still applicable.
- .2 Commissioning personnel to be fully aware of and qualified to interpret Design Criteria and Design Intents.

1.4 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Final Report: submit report to DCC Representative.
 - .1 Include measurements, final settings and certified test results.
 - .2 Bear signature of commissioning technician and supervisor
 - .3 Report format to be approved by DCC Representative before commissioning is started.

- .4 Revise "as-built" documentation, commissioning reports to reflect changes, adjustments and modifications to EMCS as set during commissioning and submit to DCC Representative in accordance with Section 01 78 00 - Closeout Submittals.
- .5 Recommend additional changes and/or modifications deemed advisable in order to improve performance, environmental conditions or energy consumption.

1.5 CLOSEOUT SUBMITTALS

- .1 Provide documentation, O&M Manuals, and training of O&M personnel for review of DCC Representative before interim acceptance in accordance with Section 01 78 00 - Closeout Submittals.

1.6 COMMISSIONING

- .1 Do commissioning in accordance with Section 01 91 13 - COMMISSIONING.
- .2 Carry out commissioning under direction of DCC Representative and in presence of DCC Representative and PWGSC Commissioning Manager.
- .3 Inform, and obtain approval from, DCC Representative in writing at least 14 days before commissioning or each test. Indicate:
 - .1 Location and part of system to be tested or commissioned.
 - .2 Testing/commissioning procedures, anticipated results.
 - .3 Names of testing/commissioning personnel.
- .4 Correct deficiencies, re-test in presence of DCC Representative until satisfactory performance is obtained.
- .5 Acceptance of tests will not relieve Contractor from responsibility for ensuring that complete systems meet every requirement of Contract.
- .6 Load system with project software.
- .7 Perform tests as required.

1.7 COMPLETION OF COMMISSIONING

- .1 Commissioning to be considered as satisfactorily completed when objectives of commissioning have been achieved and reviewed by DCC Representative and PWGSC Commissioning Manager.

1.8 ISSUANCE OF FINAL CERTIFICATE OF COMPLETION

- .1 Final Certificate of Completion will not be issued until receipt of written approval indicating successful completion of specified commissioning activities including receipt of commissioning documentation.

Part 2 Products

2.1 EQUIPMENT

- .1 Provide sufficient instrumentation to verify and commission the installed system. Provide two-way radios.
- .2 Instrumentation accuracy tolerances: higher order of magnitude than equipment or system being tested.
- .3 Independent testing laboratory to certify test equipment as accurate to within approved tolerances no more than 2 months before tests.
- .4 Locations to be approved, readily accessible and readable.
- .5 Application: to conform to normal industry standards.

Part 3 Execution

3.1 PROCEDURES

- .1 Test each system independently and then in unison with other related systems.
- .2 Commission each system using procedures prescribed by the DCC Representative.
- .3 Commission integrated systems using procedures prescribed by Commissioning Manager and DCC Representative.
- .4 Debug system software.
- .5 Optimize operation and performance of systems by fine-tuning PID values and modifying CDLs as required.
- .6 Test full scale emergency evacuation and life safety procedures including operation and integrity of smoke management systems under normal and emergency power conditions as applicable.

3.2 SITE QUALITY CONTROL

- .1 Pre-Installation Testing.
 - .1 General: consists of site tests of equipment just before installation.
 - .2 Testing may be on site or at Contractor's premises as approved by DCC Representative.
 - .3 Configure major components to be tested in same architecture as designed system. Include BECC equipment and 2 sets of Building Controller's including MCU's, LCU's, and TCU's.
 - .4 Equip each Building Controller with sensor and controlled device of each type (AI, AO, DI, DO).
 - .5 Additional instruments to include:
 - .1 DP transmitters.

- .2 VAV supply duct SP transmitters.
- .3 DP switches used for dirty filter indication and fan status.
- .6 In addition to test equipment, provide inclined manometer, digital micro-manometer, milli-amp meter, source of air pressure infinitely adjustable between 0 and 500 Pa, to hold steady at any setting and with direct output to milli-amp metre at source and to BECC.
- .7 After setting, test zero and span in 10% increments through entire range while both increasing and decreasing pressure.
- .8 DCC Representative to mark instruments tracking within 0.5 % in both directions as "approved for installation".
- .9 Transmitters above 0.5 % error will be rejected.
- .10 DP switches to open and close within 2% of setpoint.
- .2 Completion Testing.
 - .1 General: test after installation of each part of system and after completion of mechanical and electrical hook-ups, to verify correct installation and functioning.
 - .2 Include following activities:
 - .1 Test and calibrate site hardware including stand-alone capability of each controller.
 - .2 Verify each A-to-D convertor.
 - .3 Test and calibrate each AI using calibrated digital instruments.
 - .4 Test each DI to ensure proper settings and switching contacts.
 - .5 Test each DO to ensure proper operation and lag time.
 - .6 Test each AO to ensure proper operation of controlled devices. Verify tight closure and signals.
 - .7 Test operating software.
 - .8 Test application software and provide samples of logs and commands.
 - .9 Verify each CDL including energy optimization programs.
 - .10 Debug software.
 - .11 Blow out flow measuring and static pressure stations with high pressure air at 700 kPa.
 - .12 Provide point verification list in table format including point identifier, point identifier expansion, point type and address, low and high limits and engineering units. Include space on commissioning technician and DCC Representative. This document will be used in final startup testing.
 - .3 Final Startup Testing: Upon satisfactory completion of tests, perform point-by-point test of entire system under direction of DCC Representative and PWGSC Commissioning Manager and provide:
 - .1 2 technical personnel capable of re-calibrating site hardware and modifying software.
 - .2 Detailed daily schedule showing items to be tested and personnel available.
 - .3 DCC Representative's acceptance signature to be on executive and applications programs.
 - .4 Commissioning to commence during final startup testing.

- .5 O&M personnel to assist in commissioning procedures as part of training.
- .6 Commissioning to be supervised by qualified supervisory personnel and DCC Representative.
- .7 Commission systems considered as life safety systems before affected parts of the facility are occupied.
- .8 Operate systems as long as necessary to commission entire project.
- .9 Monitor progress and keep detailed records of activities and results.
- .4 Final Operational Testing: to demonstrate that EMCS functions in accordance with contract requirements.
 - .1 Before beginning of 30 day test demonstrate that operating parameters (setpoints, alarm limits, operating control software, sequences of operation, trends, graphics and CDL's) have been implemented to ensure proper operation and operator notification in event of off-normal operation.
 - .1 Repetitive alarm conditions to be resolved to minimize reporting of nuisance conditions.
 - .2 Test to last at least 30 consecutive 24 hour days.
 - .3 Tests to include:
 - .1 Demonstration of correct operation of monitored and controlled points.
 - .2 Operation and capabilities of sequences, reports, special control algorithms, diagnostics, software.
 - .4 System will be accepted when:
 - .1 EMCS equipment operates to meet overall performance requirements. Downtime as defined in this Section must not exceed allowable time calculated for this site.
 - .2 Requirements of Contract have been met.
 - .5 In event of failure to attain specified AEL during test period, extend test period on day-to-day basis until specified AEL is attained for test period.
 - .6 Correct defects when they occur and before resuming tests.
- .5 Commissioning Manager and DCC Representative to verify reported results.

3.3 ADJUSTING

- .1 Final adjusting: upon completion of commissioning as reviewed by DCC Representative, set and lock devices in final position and permanently mark settings.

3.4 DEMONSTRATION

- .1 Demonstrate to Commissioning Manager and DCC Representative operation of systems including sequence of operations in regular and emergency modes, under normal and emergency conditions, start-up, shut-down interlocks and lock-outs in accordance with Section 01 79 00 - Demonstration and Training.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 25 05 02 - EMCS: Submittals and Review Process
- .2 Section 25 05 54 - EMCS: Identification

1.2 ABBREVIATIONS AND ACRONYMS

- .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 Centre.
 - .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.

1.3 DEFINITIONS

- .1 Point: may be logical or physical.
 - .1 Logical points: values calculated by system such as setpoints, totals, counts, derived corrections and may include, but not limited to result of and statements in CDL's.
 - .2 Physical points: inputs or outputs which have hardware wired to controllers which are measuring physical properties, or providing status conditions of contacts or relays which provide interaction with related equipment (stop, start) and valve or damper actuators.
- .2 Point Name: composed of two parts, point identifier and point expansion.
 - .1 Point identifier: comprised of three descriptors, "area" descriptor, "system" descriptor and "point" descriptor, for which database to provide 25 character field for each point identifier. "System" is system that point is located on.
 - .1 Area descriptor: building or part of building where point is located.
 - .2 System descriptor: system that point is located on.
 - .3 Point descriptor: physical or logical point description. For point identifier "area", "system" and "point" will be shortforms or acronyms. Database must provide 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 field for each point expansion.
 - .3 Bilingual systems to include additional point identifier expansion sites of equal capacity for each point name for second language.
 - .1 System to support use of numbers and readable characters including blanks, periods or underscores to enhance user readability for each of the above strings.
- .3 Point Object Type: points fall into following object types:
 - .1 AI (analog input).
 - .2 AO (analog output).
 - .3 DI (digital input).
 - .4 DO (digital output).
 - .5 Pulse inputs.

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

1.4 REFERENCE STANDARDS

- .1 American National Standards Institute (ANSI)/The Instrumentation, Systems and Automation Society (ISA):
 - .1 ANSI/ISA 5.5-1985, Graphic Symbols for Process Displays
- .2 American National Standards Institute (ANSI)/ Institute of Electrical and Electronics Engineers (IEEE):
 - .1 ANSI/IEEE 260.1-1993, American National Standard Letter Symbols Units of Measurement (SI Units, Customary Inch-Pound Units, and Certain Other Units)
- .3 American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc. (ASHRAE):
 - .1 ASHRAE STD 135-R2001, BACNET - Data Communication Protocol for Building Automation and Control Network
- .4 CSA Group (CSA):
 - .1 CAN/CSA-Z234.1-89, Canadian Metric Practice Guide
- .5 Consumer Electronics Association (CEA):
 - .1 CEA-709.1-B-2002, Control Network Protocol Specification
- .6 Department of Justice Canada (Jus):
 - .1 Canadian Environmental Assessment Act (CEAA), 1995, c. 37
 - .2 Canadian Environmental Protection Act (CEPA), 1999, c. 33
- .7 Electrical and Electronic Manufacturers Association (EEMAC):
 - .1 EEMAC 2Y-1-1958, Light Grey Colour for Indoor Switch Gear
- .8 Health Canada/Workplace Hazardous Materials Information System (WHMIS):
 - .1 Safety Data Sheets (SDS)
- .9 Transport Canada (TC):
 - .1 Transportation of Dangerous Goods Act (TDGA), 1992, c. 34

1.5 SYSTEM DESCRIPTION

- .1 New building control panel to be provided inside new pump building. Control wiring to be extended to existing Hangar 10 to allow remote monitoring of pump building EMCS from campus network.
- .2 EMCS to monitor the following:
 - .1 Pump building temperature via wall-mounted thermostat
 - .2 Water reservoir temperature

- .3 Trouble signal from fire pump and jockey pump controllers.
- .3 Provide the following field devices and wire to the fire pump system controls:
 - .1 Water reservoir level sensor
 - .2 Automatic fill valve to open when water reservoir level drops below level setpoint and close when reservoir is at setpoint.
 - .3 Water reservoir heater to engage when reservoir temperature drops below setpoint.
 - .4 Air intake damper actuator and end switch wired to fire pump controller.
- .4 Work covered by sections referred to above consists of fully operational EMCS, including, but not limited to, following:
 - .1 Building Controllers.
 - .2 Control devices as listed in I/O point summary tables.
 - .3 OWS(s).
 - .4 Data communications equipment necessary to effect EMCS data transmission system.
 - .5 Site control devices.
 - .6 Software/Hardware complete with full documentation.
 - .7 Complete operating and maintenance manuals.
 - .8 Training of personnel.
 - .9 Acceptance tests, technical support during commissioning, full documentation.
 - .10 Wiring interface coordination of equipment supplied by others.
 - .11 Miscellaneous work as specified in these sections and as indicated.
- .5 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 DCC Representative before installation.
 - .3 Location of controllers as reviewed by DCC Representative before installation.
 - .4 Provide utility power to EMCS and emergency power to EMCS as indicated.
 - .5 Metric references: in accordance with CAN/CSA Z234.1.
- .6 Language Operating Requirements:
 - .1 Provide English or French operator selectable access codes.
 - .2 Use non-linguistic symbols for displays on graphic terminals wherever possible. Other information to be in English and French.
 - .3 Operating system executive: provide primary hardware-to-software interface specified as part of hardware purchase with associated documentation to be in English and French.
 - .4 System manager software: include in English and French system definition point database, additions, deletions or modifications, control loop statements, use of high level programming languages, report generator utility and other OS utilities used for maintaining optimal operating efficiency.
 - .5 Include, in English and French:

- .1 Input and output commands and messages from operator-initiated functions and site 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. To be in French and English at specified OWS and to be able to operate one terminal in English and second in French. Point name expansions in both languages.
- .3 Reporting function such as trend log, trend graphics, alarm report logs, energy report logs, maintenance generated logs.

1.6 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Make submittals in accordance with Section 01 33 00 - Submittal Procedures and 25 05 02 - EMCS: Submittals and Review Process.
- .2 Submit for review:
 - .1 Equipment list and systems manufacturers at time of tender within 48 hours within 10 days after award of contract.
 - .2 List existing site control devices to be re-used included in tender, along with unit price.
- .3 Quality Control:
 - .1 Provide equipment and material from manufacturer's regular production, CSA certified, manufactured to standard quoted plus additional specified requirements.
 - .2 Where CSA certified equipment is not available submit such equipment to inspection authorities for special inspection and approval before delivery to site.
 - .3 Submit proof of compliance to specified standards with shop drawings and product data in accordance with Section 25 05 02 - EMCS: Submittals and Review Process. Label or listing of specified organization is acceptable evidence.
 - .4 In lieu of such evidence, submit certificate from testing organization, approved by DCC 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 certificate of acceptance from authority having jurisdiction to DCC 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.
- .5 Health and Safety:
 - .1 Do construction occupational health and safety in accordance with Section 01 35 29.06 - Health and Safety Requirements.

1.8 DELIVERY, STORAGE, AND HANDLING

- .1 Material Delivery Schedule: provide DCC Representative with schedule within 2 weeks after award of Contract.
- .2 Waste Management and Disposal:
 - .1 Separate waste materials for reuse and recycling in accordance with Section 01 74 19 Waste Management and Disposal.
 - .2 Remove from site and dispose of packaging materials at appropriate recycling facilities.
 - .3 Collect and separate for disposal paper, plastic, polystyrene, corrugated cardboard, 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 Metal, 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 CEPA,TDGA,Regional and Municipal, regulations.
 - .7 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 DCC Representative.
 - .10 Fold up metal and plastic banding, flatten and place in designated area for recycling.

1.9 EXISTING-CONTROL COMPONENTS

- .1 Utilize existing control wiring and piping as indicated.
- .2 Re-use site control devices that are usable in their original configuration provided that they conform to applicable codes, standards specifications.
 - .1 Do not modify original design of existing devices without written permission from DCC Representative.
 - .2 Provide for new, properly designed device where re-usability of components is uncertain.
- .3 Inspect and test existing devices intended for re-use within 30 days of award of contract, and before installation of new devices.

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

Part 2 Products

2.1 EQUIPMENT

- .1 Control Network Protocol and Data Communication Protocol: to 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 Painting: as follows:

- .1 Clean and touch up marred or scratched surfaces of factory finished equipment to match original finish.
- .2 Restore to new condition, finished surfaces too extensively damaged to be primed and touched up to make good.
- .3 Clean and prime exposed hangers, racks, fastenings, and other support components.
- .4 Paint unfinished equipment installed indoors to EEMAC 2Y-1 .

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 25 01 11 - EMCS: Start-up, Verification and Commissioning
- .2 Section 25 05 01 - EMCS: General Requirements

1.2 DEFINITIONS

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

1.3 DESIGN REQUIREMENTS

- .1 Preliminary Design Review: to contain following contractor and systems information.
 - .1 Location of local office.
 - .2 Description and location of installing and servicing technical staff.
 - .3 Location and qualifications of programming design and programming support staff.
 - .4 List of spare parts.
 - .5 Location of spare parts stock.
 - .6 Names of sub-contractors and site-specific key personnel.
 - .7 Sketch of site-specific system architecture.
 - .8 Specification sheets for each item including memory provided, programming language, speed, type of data transmission.
 - .9 Descriptive brochures.
 - .10 Sample CDL and graphics (systems schematics).
 - .11 Response time for each type of command and report.
 - .12 Item-by-item statement of compliance.
 - .13 Proof of demonstrated ability of system to communicate utilizing BACnet.

1.4 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submittals in accordance with Section 01 33 00 - Submittal Procedures and coordinate with requirements in this Section.
- .2 Submit preliminary design document within 5 working days after tender closing and before contract award, for review by DCC Representative.
- .3 Shop Drawings to consist of 3 hard copies and 1 soft copy of design documents, shop drawings, product data and software.
- .4 Hard copy to be completely indexed and coordinated package to assure compliance with contract requirements and arranged in same sequence as specification and cross-referenced to specification section and paragraph number.

- .5 Soft copy to be in Autocad - latest version and Microsoft Word latest version format, structured using menu format for easy loading and retrieval on OWS.

1.5 PRELIMINARY SHOP DRAWING REVIEW

- .1 Submit preliminary shop drawings within 30 working days of award of contract and include following:
 - .1 Specification sheets for each item. To include manufacturer's descriptive literature, manufacturer's installation recommendations, specifications, drawings, diagrams, performance and characteristic curves, catalogue cuts, manufacturer's name, trade name, catalogue or model number, nameplate data, size, layout, dimensions, capacity, other data to establish compliance.
 - .2 Detailed system architecture showing all points associated with each controller including, signal levels, pressures where new EMCS ties into existing control equipment.
 - .3 Spare point capacity of each controller by number and type.
 - .4 Controller locations.
 - .5 Auxiliary control cabinet locations.
 - .6 Single line diagrams showing cable routings, conduit sizes, spare conduit capacity between control centre, site controllers and systems being controlled.
 - .7 Valves: complete schedule listing including following information: designation, service, manufacturer, model, point ID, design flow rate, design pressure drop, required Cv, Valve size, actual Cv, spring range, pilot range, required torque, actual torque and close off pressure (required and actual).
 - .8 Dampers: sketches showing module assembly, interconnecting hardware, operator locations, operator spring range, pilot range, required torque, actual torque.
 - .9 Flow measuring stations: complete schedule listing designation, service, point ID, manufacturer, model, size, velocity at design flow rate, manufacturer, model and range of velocity transmitter.
 - .10 Compressor schematic and sizing data.

1.6 DETAILED SHOP DRAWING REVIEW

- .1 Submit detailed shop drawings within 60 working days after award of contract and before start of installation and include following:
 - .1 Corrected and updated versions (hard copy only) of submissions made during preliminary review.
 - .2 Wiring diagrams.
 - .3 Piping diagrams and hook-ups.
 - .4 Interface wiring diagrams showing termination connections and signal levels for equipment to be supplied by others.
 - .5 Shop drawings for each input/output point, sensors, transmitters, showing information associated with each particular point including:
 - .1 Sensing element type and location.
 - .2 Transmitter type and range.
 - .3 Associated site wiring schematics, schedules and terminations.

- .4 Pneumatic schematics and schedules.
- .5 Complete Point Name Lists.
- .6 Setpoints, curves or graphs and alarm limits (high and low, 3 types critical, cautionary and maintenance), signal range.
- .7 Software and programming details associated with each point.
- .8 Manufacturer's recommended installation instructions and procedures.
- .9 Input and output signal levels or pressures where new system ties into existing control equipment.
- .6 Control schematics, narrative description, CDL's fully showing and describing automatic and manual procedure required to achieve proper operation of project, including under complete failure of EMCS.
- .7 Graphic system schematic displays of air and water systems with point identifiers and textual description of system, and typical floor plans as specified.
- .8 Complete system CDL's including companion English language explanations on same sheet but with different font and italics. CDL's to contain specified energy optimization programs.
- .9 Listing and example of specified reports.
- .10 Listing of time of day schedules.
- .11 Mark up to-scale construction drawing to detail control room showing location of equipment and operator work space.
- .12 Type and size of memory with statement of spare memory capacity.
- .13 Full description of software programs provided.
- .14 Sample of "Operating Instructions Manual" to be used for training purposes.
- .15 Outline of proposed start-up and verification procedures. Refer to Section 25 01 11 - EMCS: Start-up, Verification and Commissioning.

1.7 QUALITY ASSURANCE

- .1 Preliminary Design Review Meeting: Convene meeting within 45 working days of award of contract to:
 - .1 Undertake functional review of preliminary design documents, resolve inconsistencies.
 - .2 Resolve conflicts between Contract Document requirements and actual items (e.g.: points list inconsistencies).
 - .3 Review interface requirements of materials supplied by others.
 - .4 Review "Sequence of Operations".
- .2 Contractor's programmer to attend meeting.
- .3 DCC Representative retains right to revise sequence or subsequent CDL prior to software finalization without cost to DCC Representative.

Part 2 Products

2.1 NOT USED

.1 Not Used.

Part 3 Execution

3.1 NOT USED

.1 Not Used.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 25 05 01 - EMCS: General Requirements

1.2 DEFINITIONS

- .1 For acronyms and definitions refer to Section 25 05 01 - EMCS: General Requirements.

1.3 REFERENCE STANDARDS

- .1 CSA Group (CSA):
 - .1 CSA C22.1-02, The Canadian Electrical Code, Part I (19th Edition), Safety Standard for Electrical Installations

1.4 SYSTEM DESCRIPTION

- .1 Language Operating Requirements: provide identification for control items in English and French.

1.5 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submittals in accordance with Section 01 33 00 - Submittal Procedures supplemented and modified by requirements of this Section.
- .2 Submit to DCC Representative for approval samples of nameplates, identification tags and list of proposed wording.

Part 2 Products

2.1 NAMEPLATES FOR PANELS

- .1 Identify by Plastic laminate, 3 mm thick Melamine, matt white finish, black core, square corners, lettering accurately aligned and engraved into core.
- .2 Sizes: 25 x 67 mm minimum.
- .3 Lettering: minimum 7 mm high, black.
- .4 Inscriptions: machine engraved to identify function.

2.2 NAMEPLATES FOR SITE DEVICES

- .1 Identify by plastic encased cards attached by plastic tie.
- .2 Sizes: 50 x 100 mm minimum.
- .3 Lettering: minimum 5 mm high produced from laser printer in black.

- .4 Data to include: point name and point address.
- .5 Companion cabinet: identify interior components using plastic enclosed cards with point name and point address.

2.3 NAMEPLATES FOR ROOM SENSORS

- .1 Identify by stick-on labels using point identifier.
- .2 Location: as directed by DCC Representative.
- .3 Letter size: to suit, clearly legible.

2.4 WARNING SIGNS

- .1 Equipment including motors, starters under remote automatic control: supply and install orange coloured signs warning of automatic starting under control of EMCS.
- .2 Sign to read: "Caution: This equipment is under automatic remote control of EMCS" as reviewed by DCC Representative.

2.5 WIRING

- .1 Supply and install numbered tape markings on wiring at panels, junction boxes, splitters, cabinets and outlet boxes.
- .2 Colour coding: to CSA C22.1. Use colour coded wiring in communications cables, matched throughout system.
- .3 Power wiring: identify circuit breaker panel/circuit breaker number inside each EMCS panel.

2.6 CONDUIT

- .1 Colour code EMCS conduit.
- .2 Pre-paint box covers and conduit fittings.
- .3 Coding: use fluorescent orange paint and confirm colour with DCC Representative during "Preliminary Design Review".

Part 3 Execution

3.1 NAMEPLATES AND LABELS

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

3.2 EXISTING PANELS

- .1 Correct existing nameplates and legends to reflect changes made during Work.

National Defence	EMCS: IDENTIFICATION	Section 25 05 54
8 Wing Trenton		Page 3
Project No: 500006750		2025-11-20

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 25 05 54 - EMCS: Identification
- .2 Section 25 08 20 - EMCS: Warranty and Maintenance
- .3 Section 26 05 00 - Common Work Results for Electrical

1.2 REFERENCE STANDARDS

- .1 American National Standards Institute (ANSI):
 - .1 ANSI/ASME B16.22-2013, Wrought Copper and Copper Alloy Solder Joint Pressures Fittings
 - .2 ANSI C2-1990, National Electrical Safety Code
 - .3 ANSI/NFPA 70-1990, National Electrical Code
- .2 CSA Group (CSA):
 - .1 CSA C22.1-18, Canadian Electrical Code, Part I (24th Edition), Safety Standard for Electrical Installations
 - .2 CAN/CSA C22.2 No. 45.1-07, Electrical Rigid Metal Conduit
 - .3 CAN/CSA C22.2 No. 56-17, Flexible Metal Conduit and Liquid-Tight Flexible Metal Conduit
 - .4 CAN/CSA C22.2 No. 83-M1985, Electrical Metallic Tubing
 - .5 CAN/CSA-C22.3 No. 1-15, Overhead Systems
 - .6 CAN/CSA-C22.3 No. 7-15, Underground Systems

1.3 SYSTEM DESCRIPTION

- .1 Electrical:
 - .1 Provide power wiring from existing power panels to EMCS field panels. Circuits to be for exclusive use of EMCS equipment. Panel breakers to be identified on panel legends tagged and locks applied to breaker switches.
 - .2 Hard wiring between field control devices and EMCS field panels.
 - .3 Communication wiring between EMCS field panels and OWS's including main control centre BECC.
 - .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 engineer before commencing work.
- .2 Mechanical:
 - .1 Pipe Taps Required For EMCS equipment will be supplied and installed by Division 23.

- .2 Wells and Control Valves Shall Be Supplied by EMCS Contractor and Installed by Division 23.
- .3 Installation of air flow stations, dampers, and other devices requiring sheet metal trades to be mounted by Division 23. Costs to be carried by designated trade.

1.4 PERSONNEL QUALIFICATIONS

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

1.5 EXISTING CONDITIONS

- .1 Repair all surfaces damaged during execution of work.
- .2 Turn over to DCC Representative existing materials removed from work not identified for re-use.

Part 2 Products

2.1 SPECIAL SUPPORTS

- .1 Structural grade steel, primed and painted after construction and before installation.

2.2 WIRING

- .1 As per requirements of Division 26.
- .2 For 70V and above copper conductor with chemically cross-linked thermosetting polyethylene insulation rated RW90 and 600V. Colour code to CSA 22.1
- .3 For wiring under 70 V use FT4 wiring in conduit.
- .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: #18 AWG.
 - .4 Analog input and output: shielded #18 minimum solid copper. Wiring must be continuous without joints.
 - .5 More than 4 conductors: #22 minimum solid copper.
- .5 Terminations:
 - .1 Terminate wires with screw terminal type connectors suitable for wire size, and number of terminations.

2.3 CONDUIT

- .1 As per requirements of Division 26.

- .2 Electrical metallic tubing to CAN/CSA C22.2 No. 83. Flexible and liquid tight flexible metal conduit to CAN/CSA C22.2 No. 56. Rigid steel threaded conduit to CAN/CSA C22.2 No. 45
- .3 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.
- .4 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.
- .5 Outlet boxes: 100 mm minimum, square.
- .6 Conduit boxes, fittings:
 - .1 Bushings and connectors: with nylon insulated throats.
 - .2 With push pennies to prevent entry of foreign materials.
- .7 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.
- .8 Fittings for thin wall conduit:
 - .1 Connectors and couplings: steel, set screw type.

2.4 WIRING DEVICES, COVER PLATES

- .1 Conform to CSA
- .2 Receptacles:
 - .1 Duplex: CSA type 5-15R
 - .2 Single: CSA type 5-15R
 - .3 Cover plates and blank plates: finish to match other plates in area.

2.5 STARTERS, CONTROL DEVICES

- .1 Across-the-line magnetic starters:
 - .1 Enclosures: CSA Type 1, except where otherwise specified
 - .2 Size, type and rating: to suit motors.
- .2 Starter diagrams:
 - .1 Provide copy of wiring and schematic diagrams - mount one copy in each starter with additional copies for operation and maintenance manual.
- .3 Auxiliary Control Devices:
 - .1 Control transformers: 60 Hz, primary voltage to suit supply, 120 V single phase secondary, VA rating to suit load plus 20% margin.

- .2 Auxiliary contacts: one "Normally Open" and one "Normally Closed" spare auxiliary contact in addition to maintained auxiliary contacts as indicated.
- .3 Hand-Off-Automatic switch: heavy duty type, knob lever operator.
- .4 Double voltage relays: with barrier to separate relay contacts from operating magnet. Operating coil voltage and contact rating as indicated.
- .4 Finish for starters:
 - .1 Exterior: in accordance with Section 26 05 00 - Common Work Results for Electrical.
 - .2 Interior: white.

2.6 SUPPORTS FOR CONDUIT, FASTENINGS, EQUIPMENT

- .1 Solid masonry, tile and plastic surfaces: lead anchors or nylon shields.
 - .1 Hollow masonry walls, suspended drywall ceilings: toggle bolts.
- .2 Exposed conduits or cables:
 - .1 50 mm diameter and smaller: one-hole steel straps.
 - .2 Larger than 50 mm diameter: two-hole steel straps.
- .3 Suspended support systems:
 - .1 Individual cable or conduit runs: support with 6 mm diameter threaded rods and support clips.
 - .2 Two or more suspended cables or conduits: support channels supported by 6 mm diameter threaded rod hangers.

Part 3 Execution

3.1 INSTALLATION

- .1 Install equipment, components so that manufacturer's and CSA labels are visible and legible after commissioning is complete

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, 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 1000 and 2000 mm above finished floor wherever possible and adjacent to related equipment.
- .7 Protect exposed live equipment such as panel, mains, outlet wiring during construction for personnel safety.
- .8 Shield and mark live parts "LIVE 120 VOLTS" or other appropriate voltage.
- .9 Install conduits, and sleeves before pouring of concrete.
- .10 Holes through exterior wall and roofs: flash and make weatherproof.
- .11 Make necessary arrangements for cutting of chases, drilling holes and other structural work required to install electrical conduit, cable, pull boxes, outlet boxes.
- .12 Install cables, conduits and fittings which are to be embedded or plastered over, neatly and closely to building structure to minimize furring.

3.4 CONDUIT SYSTEM

- .1 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.
- .2 Install conduits parallel or perpendicular to building lines, to conserve headroom and to minimize interference.
- .3 Do not run exposed conduits in normally occupied spaces unless otherwise indicated or unless impossible to do otherwise. Obtain approval from DCC 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.
- .4 Locate conduits at least 150 mm from parallel steam or hot water pipes and at least 50 mm at crossovers.
- .5 Bend conduit so that diameter is reduced by less than 1/10th original diameter.
- .6 Field thread on rigid conduit to be of sufficient length to draw conduits up tight.
- .7 Limit conduit length between pull boxes to less than 30 m.
- .8 Use conduit outlet boxes for conduit up to 32 mm diameter and pull boxes for larger sizes.
- .9 Fastenings and supports for conduits, cables, and equipment:

- .1 Provide metal brackets, frames, hangers, clamps and related types of support structures as indicated and as required to support cable and conduit runs.
- .2 Provide adequate support for raceways and cables, sloped vertically to equipment.
- .3 Use supports or equipment installed by other trades for conduit, cable and raceway supports only after written approval from DCC Representative.
- .10 Install polypropylene fish cord in empty conduits for future use.
- .11 Where conduits become blocked, remove and replace blocked sections.
- .12 Pass conduits through structural members only after receipt of DCC Representative's written approval.
- .13 Conduits may be run in flanged portion of structural steel.
- .14 Group conduits wherever possible on suspended or surface channels.
- .15 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.
- .16 Install terminal blocks or strips indicated in cabinets.
- .17 Install bonding conductor for 120 volt 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 DCC 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 STARTERS, CONTROL DEVICES

- .1 Install and make power and control connections as indicated.
- .2 Install correct over-current devices.
- .3 Identify each wire, terminal for external connections with permanent number marking identical to diagram.
- .4 Performance Verification:
 - .1 Operate switches and controls to verify functioning.
 - .2 Perform start and stop sequences of contactors and relays.
 - .3 Check that interlock sequences, with other separate related starters, equipment and auxiliary control devices, operate as specified.

3.8 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.

3.9 TESTS

- .1 General:

- .1 Perform following tests in addition to tests specified Section 25 08 20 - EMCS: Warranty and Maintenance.
- .2 Give 14 days written notice of intention to test.
- .3 Conduct in presence of DCC Representative and authority having jurisdiction.
- .4 Conceal work only after tests satisfactorily completed.
- .5 Report results of tests to DCC Representative in writing.
- .6 Preliminary tests:
 - .1 Conduct as directed to verify compliance with specified requirements.
 - .2 Make needed changes, adjustments, replacements.
 - .3 Insulation resistance tests:
 - .1 Megger all circuits, feeders, equipment for 120 - 600V with 1000V 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 DCC Representative and authority having jurisdiction.

3.10 IDENTIFICATION

- .1 Refer to Section 25 05 54 - EMCS: Identification.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 25 05 01 - EMCS: General Requirements

1.2 DEFINITIONS

- .1 BC(s) - Building Controller(s).
- .2 OWS - Operator Work Station.
- .3 For additional acronyms and definitions refer to Section 25 05 01 - EMCS: General Requirements.

1.3 REFERENCE STANDARDS

- .1 Canada Labour Code (R.S. 1985, c. L-2)/Part I - Industrial Relations
- .2 CSA Group (CSA):
 - .1 CSA Z204-94, Guidelines for Managing Indoor Air Quality in Office Buildings

1.4 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Submit detailed preventative maintenance schedule for system components to DCC Representative.
- .3 Submit detailed inspection reports to DCC Representative.
- .4 Submit dated, maintenance task lists to DCC Representative and include the following sensor and output point detail, as proof of system verification:
 - .1 Point name and location.
 - .2 Device type and range.
 - .3 Measured value.
 - .4 System displayed value.
 - .5 Calibration detail
 - .6 Indication if adjustment required,
 - .7 Other action taken or recommended.
- .5 Submit network analysis report showing results with detailed recommendations to correct problems found.
- .6 Records and logs: in accordance with Section 01 78 00 - Closeout Submittals.
 - .1 Maintain records and logs of each maintenance task on site.

- .2 Organize cumulative records for each major component and for entire EMCS chronologically.
- .3 Submit records to DCC Representative, after inspection indicating that planned and systematic maintenance have been accomplished.
- .7 Revise and submit to DCC Representative in accordance with Section 01 78 00 - Closeout Submittals "As-built drawings" documentation and commissioning reports to reflect changes, adjustments and modifications to EMCS made during warranty period.

1.5 MAINTENANCE SERVICE DURING WARRANTY PERIOD

- .1 Provide services, materials, and equipment to maintain EMCS for specified warranty period. Provide detailed preventative maintenance schedule for system components as described in Submittal article.
- .2 Emergency Service Calls:
 - .1 Initiate service calls when EMCS is not functioning correctly.
 - .2 Qualified control personnel to be available during warranty period to provide service to "CRITICAL" components whenever required at no extra cost.
 - .3 Furnish DCC Representative with telephone number where service personnel may be reached at any time.
 - .4 Service personnel to be on site ready to service EMCS within 2 hours after receiving request for service.
 - .5 Perform Work continuously until EMCS restored to reliable operating condition.
- .3 Operation: foregoing and other servicing to provide proper sequencing of equipment and satisfactory operation of EMCS based on original design conditions and as recommended by manufacturer.
- .4 Work requests: record each service call request, when received separately on approved form and include:
 - .1 Serial number identifying component involved.
 - .2 Location, date and time call received.
 - .3 Nature of trouble.
 - .4 Names of personnel assigned.
 - .5 Instructions of work to be done.
 - .6 Amount and nature of materials used.
 - .7 Time and date work started.
 - .8 Time and date of completion.
- .5 Provide system modifications in writing.
 - .1 No system modification, including operating parameters and control settings, to be made without prior written approval of DCC Representative.

Part 2 Products

2.1 NOT USED

- .1 Not Used.

Part 3 Execution

3.1 SITE QUALITY CONTROL

- .1 Perform as minimum (3) three minor inspections and one major inspection (more often if required by manufacturer) per year. Provide detailed written report to DCC Representative as described in Submittal article.
- .2 Perform inspections during regular working hours, 0800 to 1630 h, Monday through Friday, excluding statutory holidays.
- .3 Following inspections are minimum requirements and should not be interpreted to mean satisfactory performance:
 - .1 Perform calibrations using test equipment having traceable, certifiable accuracy at minimum 50% greater than accuracy of system displaying or logging value.
 - .2 Check and Calibrate each site input/output device in accordance with Canada Labour Code - Part I and CSA Z204.
 - .3 Provide dated, maintenance task lists, as described in Submittal article, as proof of execution of complete system verification.
- .4 Minor inspections to include, but not limited to:
 - .1 Perform visual, operational checks to BC's, peripheral equipment, interface equipment and other panels.
 - .2 Check equipment cooling fans as required.
 - .3 Visually check for mechanical faults, air leaks and proper pressure settings on pneumatic components.
 - .4 Review system performance with DCC Representative to discuss suggested or required changes.
- .5 Major inspections to include, but not limited to:
 - .1 Minor inspection.
 - .2 Clean OWS(s) peripheral equipment, BC(s), interface and other panels, micro-processor interior and exterior surfaces.
 - .3 Check signal, voltage and system isolation of BC(s), peripherals, interface and other panels.
 - .4 Verify calibration/accuracy of each input and output device and recalibrate or replace as required.
 - .5 Provide mechanical adjustments, and necessary maintenance on printers.
 - .6 Run system software diagnostics as required.

- .7 Install software and firmware enhancements to ensure components are operating at most current revision for maximum capability and reliability.
 - .1 Perform network analysis and provide report as described in Submittal article.
- .6 Rectify deficiencies revealed by maintenance inspections and environmental checks.
- .7 Continue system debugging and optimization.
- .8 Testing/verification of occupancy and seasonal-sensitive systems to take place during four (4) consecutive seasons, after facility has been accepted, taken over and fully occupied.
 - .1 Test weather-sensitive systems twice: first at near winter design conditions and secondly under near summer design conditions.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 25 05 01 - EMCS: General Requirements
- .2 Section 25 05 02 - EMCS: Submittals and Review Process

1.2 DEFINITIONS

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

1.3 REFERENCE STANDARDS

- .1 American Society of Heating, Refrigeration and Air-Conditioning Engineers, Inc. (ASHRAE):
 - .1 ASHRAE 2003, Applications Handbook, SI Edition
- .2 CSA Group (CSA):
 - .1 C22.2 No.205-M1983, 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 MD13800-September 2000, Energy Management and Control Systems (EMCS) Design Manual. English: <ftp://ftp.pwgsc.gc.ca/rps/docentre/mechanical/me214-e.pdf>

1.4 DESCRIPTION

- .1 General: Network of controllers comprising of MCU('s), LCU('s), ECU('s) or TCU('s) to be provided as indicated in System Architecture Diagram to support building systems and associated sequence(s) 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 DCC Representative at time of preliminary design review.
- .2 Controllers: stand-alone intelligent Control Units.
 - .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 site 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 Controller(s).

- .1 Secondary input used for reset such as outdoor air temperature may be located in other Controller(s).
- .3 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 To include:
 - .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 Site Termination and Interface Devices:
 - .1 To: CSA C22.2 No.205.
 - .2 Electronically interface sensors and control devices to processor unit.
 - .3 Include, but not be limited to, following:
 - .1 Programmed firmware or logic circuits to meet functional and technical requirements.
 - .2 Power supplies for operation of logics devices and associated site equipment.
 - .3 Lockable wall cabinet.
 - .4 Required communications equipment and wiring (if remote units).
 - .5 Leave controlled system in "fail-safe" mode in event of loss of communication with, or failure of, processor unit.
 - .6 Input Output interface to accept as minimum AI, AO, DI, DO functions as specified.
 - .7 Wiring terminations: use conveniently located screw type or spade lug terminals.
- .4 AI interface equipment to:
 - .1 Convert analog signals to digital format with 10 bit analog-to-digital resolution.
 - .2 Provide for following input signal types and ranges:
 - .1 4 - 20 mA;
 - .2 0 - 10 V DC;
 - .3 100/1000 ohm RTD input;

- .3 Meet IEEE C37.90.1 surge withstand capability.
- .4 Have common mode signal rejection greater than 60 dB to 60 Hz.
- .5 Where required, dropping resistors to be certified precision devices which complement accuracy of sensor and transmitter range specified.
- .5 AO interface equipment:
 - .1 Convert digital data from controller processor to acceptable analog output signals using 8 bit digital-to-analog resolution.
 - .2 Provide for following output signal types and ranges:
 - .1 4 - 20 mA.
 - .2 0 - 10 V DC.
 - .3 Meet IEEE C37.90.1 surge withstand capability.
- .6 DI interface equipment:
 - .1 Able to reliably detect contact change of sensed site contact and transmit condition to controller.
 - .2 Meet IEEE C37.90.1 surge withstand capability.
 - .3 Accept pulsed inputs up to 2 kHz.
- .7 DO interface equipment:
 - .1 Respond to controller processor output, switch respective outputs. Each DO hardware to be capable of switching up to 0.5 amps at 24 V AC.
 - .2 Switch up to 5 amps at 220 V AC using optional interface relay.
- .4 Controllers and associated hardware and software: operate in conditions of 0°C to 44°C and 20 % to 90 % non-condensing RH.
- .5 Controllers (MCU, LCU): mount in wall mounted cabinet with hinged, keyed-alike locked door.
 - .1 Provide for conduit entrance from top, bottom or sides of panel.
 - .2 ECUs and TCUs to be mounted in equipment enclosures or separate enclosures.
 - .3 Mounting details as approved by DCC Representative for ceiling mounting.
- .6 Cabinets to provide protection from water dripping from above, while allowing sufficient airflow to prevent internal overheating.
- .7 Provide surge and low voltage protection for interconnecting wiring connections.

1.6 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Make submittals in accordance with Section 01 33 00 - Submittal Procedures and Section 25 05 02 - EMCS: Submittals and Review Process.
 - .1 Submit product data sheets for each product item proposed for this project.

1.7 MAINTENANCE

- .1 Provide manufacturers recommended maintenance procedures for insertion in operation and maintenance manuals.

Part 2 Products

2.1 LOCAL CONTROL UNIT (LCU)

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

2.2 TERMINAL/EQUIPMENT CONTROL UNIT (TCU/ECU)

- .1 Microprocessor capable of supporting necessary software and hardware to meet TCU/ECU functional specifications.
 - .1 TCU/ECU definition to be consistent with those defined in ASHRAE HVAC Applications Handbook section 45.
- .2 Controller to communicate directly with EMCS through EMCS LAN and provide access from EMCS OWS for setting occupied and unoccupied space temperature setpoints, flow setpoints, and associated alarm values, permit reading of sensor values, site control values (% open) and transmit alarm conditions to EMCS OWS.

2.3 SOFTWARE

- .1 General:
 - .1 Include as minimum: operating system executive, communications, application programs, operator interface, and systems sequence of operation - CDL's.
 - .2 Include "firmware" or instructions which are programmed into ROM, EPROM, EEPROM, or other non-volatile memory.
 - .3 Include initial programming of Controllers, for entire system.
- .2 Program and data storage.
 - .1 Store executive programs and site configuration data in ROM, EEPROM, or other non-volatile memory.

- .2 Maintain CDL and operating data including setpoints, operating constants, alarm limits in battery-backed RAM or EEPROM for display and modification by operator.
- .3 Programming languages.
 - .1 Program Control Description Logic software (CDL) using English like or graphical, high level, general control language.
 - .2 Structure software in modular fashion to permit simple restructuring of program modules if future software additions or modifications are required. GO TO constructs not allowed unless approved by DCC 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).
- .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.
 - .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 analyse 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 analyse 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 ensure that only principal alarms are reported to OWS. Events which occur as direct result of primary event to be suppressed by system and only events which fail to occur to be reported. Such event sequence to be identified in I/O Summary and sequence of operation. Examples of above are, operational temperature alarms limits which are exceeded when main air handler is stopped, or General Fire condition shuts air handlers down, only Fire alarm status shall be reported. Exception is, when air handler which is supposed to stop or start fails to do so under event condition.
- .8 Function/Event Totalization: features to provide predefined reports which show daily, weekly, and monthly accumulating totals and which include high rate (time stamped) and low rate (time stamped) and accumulation to date for month.
 - .1 MCUs to accumulate and store automatically run-time for binary input and output points.
 - .2 MCU to automatically sample, calculate and store consumption totals on daily, weekly or monthly basis for user-selected analog or binary pulse input-type points.
 - .3 MCU to automatically count events (number of times pump is cycled off and on) daily, weekly or monthly basis.
 - .4 Totalization routine to have sampling resolution of 1 min or less for analog inputs.
 - .5 Totalization to provide calculations and storage of accumulations up to 99,999.9 units (eg. kWh, litres, tonnes, etc.).
 - .6 Store event totalization records with minimum of 9,999,999 events before reset.
 - .7 User to be able to define warning limit and generate user-specified messages when limit reached.

2.4 LEVELS OF ADDRESS

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

2.5 POINT NAME SUPPORT

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

Part 3 Execution

3.1 LOCATION

- .1 Location of Controllers to be approved by DCC Representative.

3.2 INSTALLATION

- .1 Install Controllers in secure locking enclosures as indicated or as directed by DCC 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 Use uninterruptible Power Supply (UPS) and emergency power when equipment must operate in emergency and coordinating mode.

END OF SECTION

Part 1 General

1.1 SUMMARY

- .1 Related Sections:
 - .1 Section 23 33 15 - Dampers - Operating.
 - .2 Section 25 01 11 - EMCS: Start-Up, Verification and Commissioning.
 - .3 Section 25 05 01 - EMCS: General Requirements.
 - .4 Section 25 05 02 - EMCS: Shop Drawings, Product Data and Review Process.
 - .5 Section 25 05 54 - EMCS: Identification.
 - .6 Section 26 05 00 - Common Work Results for Electrical.
 - .7 Section 26 27 26 - Wiring Devices.

1.2 DEFINITIONS

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

1.3 REFERENCE STANDARDS

- .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 ASTM International (ASTM):
 - .1 ASTM B 148-97(03), Standard Specification for Aluminum-Bronze Sand Castings
- .3 National Electrical Manufacturer's Association (NEMA):
 - .1 NEMA 250-03, Enclosures for Electrical Equipment (1000 Volts Maximum)
- .4 Air Movement and Control Association, Inc. (AMCA):
 - .1 AMCA Standard 500-D-98, Laboratory Method of Testing Dampers For Rating
- .5 CSA Group (CSA):
 - .1 CSA-C22.1-02, Canadian Electrical Code, Part 1 (19th Edition), Safety Standard for Electrical Installations

1.4 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit shop drawings and manufacturer's installation instructions in accordance with Section 25 05 02 - EMCS: Submittals and Review Process.
- .2 Pre-Installation Tests
 - .1 Submit samples at random from equipment shipped, as requested by DCC Representative, for testing before installation. Replace devices not meeting specified performance and accuracy.

- .3 Manufacturer's Instructions:
 - .1 Submit manufacturer's installation instructions for specified equipment and devices.

1.5 EXISTING CONDITIONS

- .1 Cutting and Patching: as specified herein.
- .2 Repair surfaces damaged during execution of Work.
- .3 Turn over to DCC Representative existing materials removed from Work not identified for re-use.

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, shockproof, vibration-proof, heat resistant assembly.
- .3 Operating conditions: 0 - 32°C with 10 - 90% RH (non-condensing) unless otherwise specified.
- .4 Terminations: use standard conduit box with slot screwdriver compression connector block unless otherwise specified.
- .5 Transmitters and sensors to be unaffected by external transmitters including walkie talkies.
- .6 Account for hysteresis, relaxation time, maximum and minimum limits in applications of sensors and controls.
- .7 Outdoor installations: use weatherproof construction in NEMA 4 enclosures.
- .8 Devices installed in user occupied space not exceed Noise Criteria (NC) of 35. Noise generated by any device must not be detectable above space ambient conditions.

2.2 TEMPERATURE SENSORS

- .1 General: except for room sensors to be resistance or thermocouple type to following requirements:
 - .1 Thermocouples: limit to temperature range of 200°C and over.
 - .2 RTD's: 100 or 1000 ohm at 0°C (plus or minus 0.2 ohms) platinum element with strain minimizing construction, 3 integral anchored leadwires. Coefficient of resistivity: 0.00385 ohms/ohm °C.
 - .3 Sensing element: hermetically sealed.
 - .4 Stem and tip construction: copper or type 304 stainless steel.
 - .5 Time constant response: less than 3 seconds to temperature change of 10°C.
 - .6 Immersion wells: NPS 3/4, stainless steel spring loaded construction, with heat transfer compound compatible with sensor. Insertion length 100 mm as indicated.

- .2 Room temperature sensors and display wall modules.
 - .1 Temperature sensing and display wall module.
 - .1 LCD display to show space temperature and temperature setpoint.
 - .2 Buttons for occupant selection of temperature setpoint and occupied/unoccupied mode.
 - .3 Jack connection for plugging in laptop personal computer for access to zone bus.
 - .4 Integral thermistor sensing element 10,000 ohm at 24°C.
 - .5 Accuracy 0.2°C over range of 0 to 70°C.
 - .6 Stability 0.02°C drift per year.
 - .7 Separate mounting base for ease of installation.
- .3 Outdoor air temperature sensors:
 - .1 Outside air type: complete with probe length 100 - 150 mm long, non-corroding shield to minimize solar and wind effects, threaded fitting for mating to 13 mm conduit, weatherproof construction in NEMA 4 enclosure

2.3 TEMPERATURE TRANSMITTERS

- .1 Requirements:
 - .1 Input circuit: to accept 3-lead, 100 or 1000 ohm at 0°C, platinum resistance detector type sensors.
 - .2 Power supply: 24 V DC into load of 575 ohms. Power supply effect less than 0.01°C per volt change.
 - .3 Output signal: 4 - 20 mA into 500 ohm maximum load.
 - .4 Input and output short circuit and open circuit protection.
 - .5 Output variation: less than 0.2% of full scale for supply voltage variation of plus or minus 10%.
 - .6 Combined non-linearity, repeatability, hysteresis effects: not to exceed plus or minus 0.5% of full scale output.
 - .7 Maximum current to 100 or 1000 ohm RTD sensor: not to exceed 25 mA.
 - .8 Integral zero and span adjustments.
 - .9 Temperature effects: not to exceed plus or minus 1.0% of full scale/ 50°C.
 - .10 Long term output drift: not to exceed 0.25% of full scale/ 6 months.
 - .11 Transmitter ranges: select narrowest range to suit application from following:
 - .1 Minus 50°C to plus 50°C, plus or minus 0.5°C.
 - .2 0 to 100°C, plus or minus 0.5°C.
 - .3 0 to 50°C, plus or minus 0.25°C.
 - .4 0 to 25°C, plus or minus 0.1°C.
 - .5 10 to 35°C, plus or minus 0.25°C.

2.4 PRESSURE TRANSDUCERS

- .1 Requirements:

- .1 Combined sensor and transmitter measuring pressure.
 - .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 ohm maximum load.
- .3 Output variations: less than 0.2% full scale for supply voltage variations of plus or minus 10%.
- .4 Combined non-linearity, repeatability, and hysteresis effects: not to exceed plus or minus 0.5% of full scale output over entire range.
- .5 Temperature effects: not to exceed plus or minus 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 Accuracy: plus or minus 1% of Full Scale.

2.5 DIFFERENTIAL PRESSURE TRANSMITTERS

- .1 Requirements:
 - .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 ohm maximum load.
 - .3 Output variations: less than 0.2% full scale for supply voltage variations of plus or minus 10 %.
 - .4 Combined non-linearity, repeatability, and hysteresis effects: not to exceed plus or minus 0.5% of full scale output over entire range.
 - .5 Integral zero and span adjustment.
 - .6 Temperature effects: not to exceed plus or minus 1.5% full scale/ 50°C.
 - .7 Over-pressure input protection to at least twice rated input pressure.
 - .8 Output short circuit and open circuit protection.
 - .9 Unit to have 12.5 mm N.P.T. conduit connection. Enclosure to be integral part of unit.

2.6 PRESSURE AND DIFFERENTIAL PRESSURE SWITCHES

- .1 Requirements:
 - .1 Internal materials: suitable for continuous contact with compressed air, water, steam, etc., as applicable.
 - .2 Adjustable setpoint and differential.
 - .3 Switch: snap action type, rated at 24 V DC.
 - .4 Switch assembly: to operate automatically and reset automatically when conditions return to normal. Over-pressure input protection to at least twice rated input pressure.
 - .5 Accuracy: within 2% repetitive switching.
 - .6 Provide switches with isolation valve and snubber, where code allows, between sensor and pressure source.
 - .7 Switches on steam and high temperature hot water service: provide pigtail syphon.

2.7 TEMPERATURE SWITCHES

- .1 Requirements:
 - .1 Operate automatically. Reset automatically, except as follows:
 - .1 Low temperature detection: manual reset.
 - .2 High temperature detection: manual reset.
 - .2 Adjustable setpoint and differential.
 - .3 Accuracy: plus or minus 1°C.
 - .4 Snap action rating: 24V DC as required. Switch to be DPST for hardwire and EMCS connections.
 - .5 Type as follows:
 - .1 Room: for wall mounting on standard electrical box with/without protective guard as indicated.
 - .2 Duct, general purpose: insertion length = 460 mm.
 - .3 Thermowell: stainless steel, with compression fitting for NPS 3/4 thermowell. Immersion length: 100 mm.
 - .4 Low temperature detection: continuous element with 6096 mm insertion length, duct mounting, to detect coldest temperature in any 30 mm length.
 - .5 Strap-on: with helical screw stainless steel clamp.

2.8 TANK LEVEL SWITCHES

- .1 Requirements:
 - .1 Indicate high/low water level and to alarm.
 - .2 For mounting on top of tank.
 - .3 Maximum operating temperature: 120°C.
 - .4 Snap action contacts rated 15 amp at 120 V.
 - .5 Adjustable setpoint and differential.

2.9 SUMP LEVEL SWITCHES

- .1 Requirements:
 - .1 Liquid level activated switch sealed in waterproof and shockproof enclosure.
 - .2 Complete with float, flexible cord, weight. Instrument casing to be suitable for immersion in measured liquid.
 - .3 N.O./N.C. Contacts rated at 15 amps at 120V AC. CSA approval for up to 250 volt 10 amps AC

2.10 CURRENT TRANSDUCERS

- .1 Requirements:
- .2 Purpose: combined sensor/transducer, to measure line current and produce proportional signal in one of following ranges:
 - .1 4-20 mA DC.

- .2 0-1 volt DC.
- .3 0-10 volts DC.
- .4 0-20 volts DC.
- .3 Frequency insensitive from 10 - 80 hz.
- .4 Accuracy to 0.5% full scale.
- .5 Zero and span adjustments. Field adjustable range to suit motor applications.
- .6 Adjustable mounting bracket to allow for secure/safe mounting inside MCC.

2.11 CURRENT SENSING RELAYS

- .1 Requirements:
 - .1 Suitable to detect belt loss or motor failure.
 - .2 Trip point adjustment, output status LED.
 - .3 Split core for easy mounting.
 - .4 Induced sensor power.
 - .5 Relay contacts: capable of handling 0.5 amps at 30 VAC / DC. Output to be NO solid state.
 - .6 Suitable for single or 3 phase monitoring. For 3-Phase applications: provide for discrimination between phases.
 - .7 Adjustable latch level.

2.12 ELECTRONIC CONTROL DAMPER ACTUATORS

- .1 Requirements:
 - .1 Direct mount proportional type as indicated.
 - .2 Spring return for "fail-safe" in Normally Open position.
 - .3 Operator: size to control dampers against maximum pressure and dynamic closing/opening pressure, whichever is greater.
 - .4 Power requirements: 5 VA maximum at 24 V AC.
 - .5 Operating range: 0 - 10 V DC or 4 - 20 mA DC.
 - .6 Damper actuator to drive damper from full open to full closed in less than 120 seconds.

2.13 CONTROL VALVES

- .1 Body: globe style.
 - .1 Flow characteristic as indicated on control valve schedule: equal percentage.
 - .2 Flow factor (KV) as indicated on control valve schedule: CV in imperial units.
 - .3 Normally closed.
 - .4 Two port, as indicated.
 - .5 Leakage rate ANSI class IV, 0.01% of full open valve capacity
 - .6 Packing easily replaceable.

- .7 Stem, stainless steel.
- .8 Plug and seat, bronze.
- .9 Disc, replaceable, material to suit application.
- .10 NPS 2 and under:
 - .1 Screwed National Pipe Thread (NPT) tapered female connections.
 - .2 Valves to ANSI Class 250, valves to bear ANSI mark
 - .3 Rangeability 50:1 minimum.
- .11 NPS 2½ and larger:
 - .1 Flanged connections.
 - .2 Valves to ANSI Class or 250, valves to bear ANSI mark
 - .3 Rangeability 100:1 minimum.

2.14 ELECTRONIC / ELECTRIC VALVE ACTUATORS

- .1 Requirements:
 - .1 Construction: steel, cast iron, aluminum.
 - .2 Control signal: 0-10V DC or 4-20 mA DC.
 - .3 Positioning time: to suit application. 90 sec maximum.
 - .4 Fail to normal position as indicated.
 - .5 Scale or dial indication of actual control valve position.
 - .6 Size actuator to meet requirements and performance of control valve specifications.
 - .7 For interior and perimeter terminal heating and cooling applications floating control actuators are acceptable.
 - .8 Minimum shut-off pressure: 60psi.

2.15 SURFACE WATER DETECTORS

- .1 Requirements:
 - .1 Provide alarm on presence of water on floor.
 - .2 Expendable cartridge sensor.
 - .3 Internal waterproof switch.
 - .4 One set of dry contacts 2 amps at 24 V.
 - .5 Unaffected by moisture in air.
 - .6 Self-powered.

2.16 PANELS

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

2.17 WIRING

- .1 In accordance with Section 26 27 26 - Wiring Devices.
- .2 For wiring under 70 volts use FT4 wiring run in conduit.
- .3 Wiring must be continuous without joints.
- .4 Sizes:
 - .1 Field wiring to digital device: #18AWG.
 - .2 Analog input and output: shielded #18 minimum solid copper.

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 Fire stopping: provide space for fire stopping in accordance with manufacturer's instructions. Maintain the fire-resistance rating integrity of the fire separation.
- .6 Electrical:
 - .1 Complete installation in accordance with Section 26 05 00 - Common Work Results for 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. Trace existing control wiring installation and provide updated wiring schematics including additions, deletions to control circuits for review by DCC 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 Maximum conduit fill not to exceed 40%.
- .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. DCC Representative to review before starting Work. Wiring in mechanical rooms, wiring in service rooms and exposed wiring must be in conduit.

3.2 TEMPERATURE AND HUMIDITY SENSORS

- .1 Stabilize to ensure minimum field adjustments or calibrations.
- .2 Readily accessible and adaptable to each type of application to allow for quick easy replacement and servicing without special tools or skills.
- .3 Outdoor installation:
 - .1 Protect from solar radiation and wind effects by non-corroding shields.
 - .2 Install in NEMA 4 enclosures
- .4 Duct installations:
 - .1 Do not mount in dead air space.
 - .2 Locate within sensor vibration and velocity limits.
 - .3 Securely mount extended surface sensor used to sense average temperature.
 - .4 Thermally isolate elements from brackets and supports to respond to air temperature only.
 - .5 Support sensor element separately from coils, filter racks.
- .5 Averaging duct type temperature sensors.
 - .1 Install averaging element horizontally across the ductwork starting 305 mm from top of ductwork. Each additional horizontal run to be no more than 305 mm from one above it. Continue until complete cross sectional area of ductwork is covered. Use multiple sensors where single sensor does not meet required coverage.
 - .2 Wire multiple sensors in series for low temperature protection applications.
 - .3 Wire multiple sensors separately for temperature measurement.
 - .4 Use software averaging algorithm to derive overall average for control purposes.
- .6 Thermowells: install for piping installations.
 - .1 Locate well in elbow where pipe diameter is less than well insertion length.
 - .2 Thermowell to restrict flow by less than 30%.
 - .3 Use thermal conducting paste inside wells.

3.3 PANELS

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

3.4 MAGNEHELIC PRESSURE INDICATORS

- .1 Install adjacent to fan system static pressure sensor and duct system velocity pressure sensor as reviewed by DCC Representative.
- .2 Locations: as indicated and as specified.

3.5 PRESSURE AND DIFFERENTIAL PRESSURE SWITCHES AND SENSORS

- .1 Install isolation valve and snubber on sensors between sensor and pressure source where code allows.

3.6 I/P TRANSDUCERS

- .1 Install air pressure gauge on outlet.

3.7 AIR PRESSURE GAUGES

- .1 Install pressure gauges on pneumatic devices, I/P, pilot positioners, motor operators, switches, relays, valves, damper operators, valve actuators.
- .2 Install pressure gauge on output of auxiliary cabinet pneumatic devices.

3.8 IDENTIFICATION

- .1 Identify field devices in accordance with Section 25 05 54 - EMCS: Identification.

3.9 AIR FLOW MEASURING STATIONS

- .1 Protect air flow measuring assembly until cleaning of ducts is completed.

3.10 TESTING AND COMMISSIONING

- .1 Calibrate and test field devices for accuracy and performance in accordance with Section 25 01 11 - EMCS: Start-up, Verification and Commissioning.

END OF SECTION

Part 1 General

1.1 DEFINITIONS

- .1 “Inspection Authority” shall mean Electrical Safety Authority of Ontario.
- .2 “Provide” shall mean supply, install, test and commission.

1.2 CODES AND STANDARDS

- .1 Comply with the following codes and standards as a minimum:
 - .1 National Building Code (latest edition)
 - .2 Canadian Electrical Code (latest edition)
 - .3 Ontario Electrical Safety Code (latest edition) and Electrical Bulletins.
 - .4 Ontario Building Code (latest edition)
 - .5 CSA Standards.
 - .6 ULC Standards.
 - .7 Requirements of authorities having jurisdiction.
- .2 Operating Voltages to CAN3-C235-83 (R2010).
- .3 Electronic Equipment:
 - .1 Electronics and other sensitive system and equipment shall be surge protected in accordance with requirements set forth in IEEE Standard 472 (ANSI/IEEE C37.90) “Guide for Surge Withstand Capability Tests”. Test results shall be recorded and handed over to the DCC Representative.
 - .2 System/equipment which may be adversely affected by short duration power blackouts (such as during lightning storms) shall be capable of riding through such a disturbance for up to two seconds (by having an internal battery back up to the memory/microprocessor, etc.).
 - .3 The above shall apply in particular, but not necessarily be limited to the following systems:
 - .1 Fire Alarm System complete with battery back-up and surge protection.
 - .2 Electronic Motor Controls and electronic components of conventional motor controls complete with surge protection and if required, battery back-up.
 - .3 Communication Systems including Telephone and Data.
 - .4 Lighting Control System

1.3 PERMITS AND FEES

- .1 Notify DCC Representative of changes required by Electrical Inspection Department prior to making changes.
- .2 Obtain and pay for necessary permits. Also pay all associated costs and fees, including any premiums applicable due to requirements for after office hours inspections.
- .3 On completion of the work furnish copies of the Certificates of Acceptance from the Inspection Authority and pertinent authorities having jurisdiction.

1.4 QUALIFICATIONS

- .1 The work of this Division shall be carried out by a contractor who holds a valid Ontario Contractor's license. Employees of the contractor carrying out this work, shall hold valid Ontario Certificates of Qualification.

1.5 SUBMISSIONS

- .1 Shop Drawings:
 - .1 Comply with the requirements of this section and all additional requirements listed below.
 - .2 Submit one (1) copy of shop drawings up to 8½ x 11" original sheet size and descriptive data for electrical equipment and components. Reproduce shop drawings on 8½ x 11" sheets, leaving the bottom and blank for apply shop drawing stamps, comments, etc.
 - .3 Each shop drawing shall clearly indicate:
 - .1 Name of Contractor.
 - .2 Name of Consultant.
 - .3 Name of Component.
 - .4 Name of Service or System.
 - .4 Show details of construction, dimensions, capacities, weights, all electrical data and performance characteristics, on shop drawings.
 - .5 All wiring diagrams, control schematics and descriptions of operation must also be included.
 - .6 Where applicable, submit pertinent shop drawings to relevant authorities for approval prior to submission to the DCC Representative.
 - .7 Review of shop drawings by the DCC Representative indicates only that the quality and general design of the equipment is acceptable. Verification of detailed design compliance, dimensions and quantities, or the location of connections to equipment, shall be the responsibility of the Contractor.
 - .8 Submit shop drawings for at least the following:
 - .1 Distribution and Branch Panelboards, Circuit Breaker, Disconnect Switch, Fuses including tripping characteristics, and complete protection co-ordination study.
 - .2 Lighting and lighting controls including exit signage.
 - .3 Include descriptions of operation together with at least the following:
 - .1 Physical sizes, assemblies, weights, etc.
 - .2 Single line and three line drawings.
 - .3 Wiring diagrams.
 - .4 Schematic/control diagrams.
 - .5 All seismic installation details for equipment and conduits.
 - .6 Schedule of all nameplates.
- .2 As-Built Drawings:
 - .1 During construction, keep on site one complete set of electrical drawings on which shall be clearly indicated all deviations made to the original design. The deviations shall include any changes to the following:
 - .1 Equipment location
 - .2 Conduit, system raceways and cable tray etc.

- .3 Circuiting and wiring
- .4 Riser diagrams and details
- .5 Control schematics
- .6 System interwiring
- .2 Keep these drawings up to date weekly and available for review on site by the DCC Representative.
- .3 Turn over to the DCC Representative a completed set of “as-built” drawings upon completion of the project. The as-built drawings shall include all changes to the work during construction. Ensure that corrections also made on floor plans, riser diagrams, details, schedules, Panel Charts etc., as applicable.
 - .1 All conduit and wiring and all deviations from circuit numbers shown on the Contract Documents.
 - .2 Revise and/or draw new riser and connection diagrams as necessary.
 - .3 Revise motor control schedules and control schematics as necessary.
 - .4 Revise and/or draw all “Details” drawings and schedules.
- .3 Operation and Maintenance Data:
 - .1 Provide Operation and Maintenance (O&M) Manuals in accordance with the requirements of this section.
 - .2 Submit one manual to the DCC Representative for approval prior to formal submission of all copies to the Owner. Include in manuals information based on the following requirement:
 - .1 Operation and maintenance instructions to be sufficiently detailed with respect to design elements, construction features and component function and maintenance requirements to permit effective start-up operation, maintenance, repair, modification, extension and expansion of any portion of the system.
 - .2 Technical data to be in the form of approved shop drawings, project data, supplemented by bulletins, component illustrations, exploded views, technical descriptions of items and parts lists. Advertising or sales literature will not be acceptable.
 - .3 Provide wiring and schematic diagrams and performance curves.
 - .4 Include names and addresses of local suppliers for all items included in maintenance manuals.
 - .5 All operation and maintenance data to be compiled in good quality, 3-ring, Type “D” binders no thicker than 50 mm and no more than 2/3 full. Binders must be clearly and permanently identified on spine and front with project name and number and the binder contents. Insert any material larger than 215 mm by 280 mm (i.e. folded prints) into appropriately sized and properly reinforced envelopes with flap to top of binder. The envelope shall be fitted into the binder rings at the appropriate location and its contents clearly identified on the front and back.
 - .6 Divide information in O&M Manuals binders into the following categories:
 - .1 Operation:
 - .1 Detailed description of operation of all systems.
 - .2 Equipment:
 - .1 Details of components used.
 - .3 Maintenance:

- .1 Trouble shooting techniques.
- .2 Lubrication and other requirements as applicable.
- .4 Spare Parts:
 - .1 Receipts for maintenance parts turned over.
- .5 Warranties:
 - .1 Outline of coverage, starting and expiry dates.
- .6 Certificates:
 - .1 Electrical Safety Authority acceptance.
 - .2 Fire Alarm Inspection and Certification
 - .3 Seismic Review Letter.
- .7 Test Reports.
 - .1 Emergency lighting test report.
 - .2 Equipment and cable test reports.
- .7 Provide Operation and Maintenance information organized in binders as detailed above, for all systems/equipment including but not necessarily limited to the following:
 - .1 Distribution and Branch Circuit Panelboards
 - .2 Dry-Type Transformers
 - .3 Low Voltage Circuit Breakers
 - .4 Lighting fixtures
 - .5 Lighting controls
 - .6 Fire Alarm System
 - .7 Communications System

1.6 DESIGN DOCUMENTS

- .1 Drawings for the electrical work are, in part diagrammatic. They are intended to convey the scope of work and to indicate the general arrangement of equipment, and outlets.
- .2 Before carrying out the work verify that there are no apparent obstructions or interferences. Changes to the work made necessary by failure to make this verification will not be considered for extra payment.
- .3 Co-ordinate equipment locations with architectural details and elevations etc. as well as millwork and pertinent furniture layouts.
- .4 The location of equipment may be changed by the DCC Representative at any time prior to installation, within a radius of 3 meters from the location shown on the drawings, at no extra cost to the Contract.

1.7 OMISSIONS AND DISCREPANCIES

- .1 The drawings, which form an integral part of this contract, shall serve as the working drawings. They indicate the general layout of the complete electrical system, arrangement of feeders, circuits, outlets, switches, controls, panelboards, distribution centres, fixtures and other work. The drawings indicate the general location and routes to be followed, but do not show all conduit and/or wiring or all the structural, mechanical and architectural details. Plan and install conduit runs respecting all applicable conditions including structural, architectural and mechanical details. Check for the locations of all expansion/building joints and ensure that all electrical installations

at or crossing these locations are as detailed and as required to compensate for the possible movement at the joint.

- .2 Bring obvious discrepancies or omissions to the attention of the DCC Representative.
- .3 The drawings and these specifications are complementary each to the other and what is called for by one shall be binding as if called for by both.

1.8 SPRINKLERPROOF EQUIPMENT

- .1 Equipment located in sprinklered rooms shall meet the requirements set out by the Inspection Authority and as listed below.
 - .1 Gaskets on doors and drip shields on: Free-standing transformers, panelboards, Splitter Troughs, Wireways, Auxiliary Gutters, Cable Troughs and Disconnect Switches and all "Systems" equipment and cabinets, e.g. Fire Alarm, Telephone, Data, etc., installed below the level of the sprinkler heads.
 - .2 Louvers facing outwards and downwards where openings are required for heat dissipation.
 - .3 CSA certified sealing rings for rigid steel galvanized conduit and CSA certified raintight connectors for steel galvanized electrical metallic tubing (EMT) where conduits enter the top or sides of enclosures.

1.9 ACCEPTABLE MANUFACTURERS

- .1 The intent of naming acceptable manufacturers in the specification is to indicate that these manufacturers are likely to have the ability to comply with the detailed requirements of the pertinent specifications. Naming of these manufacturers does not relieve the manufacturers from having to comply with all the specified requirements.

1.10 SUBSTITUTIONS

- .1 Alternative products that meet or exceed the specifications may be considered provided that adequate notice is given for review and approval and there is no adverse cost impact.

Part 2 Products

2.1 GENERAL

- .1 Equipment and material supplied as part of the electrical work shall be new and CSA approved for the application.
- .2 Special Electrical Safety Authority of Ontario inspection and approval will be considered as equivalent to CSA, but this approval must be obtained prior to delivery to the site.

2.2 INSERTS

- .1 Supply and deliver inserts, anchors, bolts, sleeves, ferrules and other items to be built into the work of other Divisions, complete with the necessary templates, instructions and assistance for locating and installing.

2.3 ACCESSORIES

- .1 Where not specifically indicated, provide standard accessory items of materials such as equipment supports, brackets, channels, protection etc. to make a complete and satisfactory installation.

2.4 FIRE PATCHING

- .1 Where conduits or single conductor cables pass through fire rated floor slabs, fire rated ceilings or fire rated walls, seal opening around same to maintain fire separating using Electrovert "Flameseal" putty #AA400, Isolatek International CAFCO Blaze shield II or Carbolite Pyrocrete 241.

2.5 PLYWOOD MOUNTING BOARDS

- .1 Surface-mounted power distribution equipment to be mounted on plywood backboards 20mm thick, finished with fireproof ASA 61 grey colour paint. G1S with the good side out. Provide all such backboards c/w non-combustible sheath (drywall) where required by Code.
- .2 Provide plywood backboards for communications and security equipment as indicated and finished as described above. Communication equipment to include but not necessarily limited to telephone, data, voice and fiber optic cable systems.
- .3 Strut supports for mounting power distribution equipment on walls are acceptable in lieu of plywood backboards. Plywood backboards must be provided in Communication/IT Rooms.

2.6 ACCESS DOORS

- .1 Provide access doors for electrical equipment, junction boxes and controls, as required to provide access for servicing and maintenance. Supply access doors for placing by trade whose work these panels are installed in.
- .2 Coordinate the location of all outlet/junction/pull boxes, and other concealed equipment requiring access so as to minimize the need for access doors. Where access doors become necessary, coordinate the size, quantity & location with the DCC Representative before installation.
- .3 Doors to be flush, 450 x 450 mm to items in 600 mm deep ceilings, 450 x 600 mm to items in ceilings deeper than 600 mm. Doors shall open 180 degrees, have rounded safety corners, concealed continuous piano hinges and anchor straps. All steel to be perma-coated. Doors to be of approved manufacture with published literature.
- .4 Access doors to be as follows:
 - .1 Plaster Ceilings and Walls: Cendrix PFI-SS, Babcock-Davis BIP or Nystrom IP.
 - .2 Acoustic Tile or Drywall: Cendrix PFI-100, Babcock-Davis BIT or Nystrom IT.
- .5 Access doors to be fire rated to match walls or ceilings which form part of a fire-rated enclosure or barrier.

2.7 FINISHES

- .1 Outdoor Electrical Equipment: "Equipment green" finish to EEMAC Y1-1-1955.
- .2 Indoor Distribution Equipment: "Light grey" to EEMAC 2Y-1-1958.

2.8 EQUIPMENT IDENTIFICATION

- .1 Identify electrical equipment with nameplates and labels as follows:

- .2 Nameplates:
- .1 Lamacoid 3 mm thick plastic engraving sheet mechanically attached with self tapping screws. Lamacoid colours to be as follows:
- .1 Black, face, white core for equipment on Utility Power.
- .2 White face, black core for communications and security equipment.
- .2 Standard nameplate sizes are as indicated below, but unless there are space restrictions, the minimum size of nameplate shall be Size 6 and the minimum size of letters shall be 6 mm.
- .3 Nameplate Sizes:
- | | Dimensions | # Lines | Letter Height |
|--------|-------------|---------|---------------|
| Size 1 | 10 x 50 mm | 1 | 3 mm |
| Size 2 | 12 x 70 mm | 1 | 5 mm |
| Size 3 | 12 x 70 mm | 2 | 3 mm |
| Size 4 | 20 x 90 mm | 1 | 8 mm |
| Size 5 | 20 x 90 mm | 2 | 5 mm |
| Size 6 | 25 x 100 mm | 1 | 12 mm |
| Size 7 | 25 x 100 mm | 2 | 6 mm |
- .4 Labels:
- .1 Embossed plastic labels with 6 mm high letters unless specified otherwise.
- .5 Wording on nameplates and labels to be approved by DCC Representative prior to manufacture. Abbreviations are not permitted on nameplates.
- .6 Allow for average of twenty-five (25) letters per nameplate and label.
- .7 Identification to be English.
- .8 Identify at least the following equipment with nameplates of sizes appropriate to the size of the equipment:
- .1 Transformers: Identify in accordance with drawings and indicate primary and secondary voltages and winding configurations, capacity and system. Also identify power source (Fed from....) and load (Feeding....).
- .2 Panels: Identify in accordance with drawings and indicate voltage, phases, current capacity, short-circuit rating, power source (Fed from...) and system. Provide also typed Panel Directories inside the panels.
- .3 Contactors, Disconnect Switches: Identify in accordance with the drawings and indicate voltage, phases, current capacity, short circuit rating, power source, system and equipment/load controlled.
- .4 Terminal Cabinets and Pullboxes: For power system equipment, indicate system, voltage, power source and load.
- .5 All Miscellaneous Electrical Equipment: Identify in accordance with drawings to clearly indicate function and system data.
- .6 Terminal Cabinets and Pullboxes: For communication systems equipment, indicate function and system data.

2.9 WIRING IDENTIFICATION

- .1 Identify wiring with permanent indelible identifying markings either numbered or coloured plastic tapes, on both ends of phase conductors of feeders and branch circuit wiring.

- .2 Maintain phase sequence and colour coding throughout.
- .3 Colour code: to CSA C22.1.
- .4 Use colour coded wired in communication cables, matched throughout system. Identify using numbers, both ends of each cable as well as each conductor in multi-conductor cables.

2.10 CONDUIT AND CABLE IDENTIFICATION

- .1 Colour code conduits, boxes and metallic sheathed cables. For boxes, identify the cover as well as inside each box.
- .2 Code with plastic tape or paint at points where conduit or cable enters wall, ceiling, or floor, and at 10 m (or less) intervals. Where tape is used, apply a minimum of two (2) wraps.
- .3 Colours: 25mm wide prime colour and 20 mm wide auxiliary colour.

	Prime	Auxiliary
Up to 600 V, Normal Power	Yellow	Green
Up to 250 V, Normal Power	Yellow	Blue
Telephone/Data System	Green	-
Cable TV System	Green	Red
Intercom	Green	Black
Security Systems	Orange	-
Fire Alarm	Red	-
Controls	Blue	-

2.11 WIRING TERMINATIONS

- .1 Lugs, terminals and screws used for terminations to be suitable for both copper and aluminum conductors.

2.12 MANUFACTURER AND CSA LABELS

- .1 Must be visible and legible after equipment is installed.

2.13 WARNING SIGNS

- .1 As specified and to meet requirements of Electrical Safety Authority of Ontario and DCC Representative.
- .2 Decal signs, minimum size 175 x 250 mm.

Part 3 Execution

3.1 COORDINATION

- .1 Cooperate and co-ordinate with other Divisions as required for a satisfactory and expeditious completion of the Work. Coordinate locations of conduits, raceways, junction and pullboxes etc., with Divisions 22 and 23 as well as other pertinent trades.
- .2 Instruct and supervise those Divisions doing related work.
- .3 Supply the measurements of equipment to other Divisions to allow for the necessary openings to be left in their work.

- .4 Locate equipment so as to maximize usable space. Install neatly and close to the building structure all raceways, fittings, pull boxes, junction boxes, wiring and cables which are to be concealed, in order that the necessary furring can be kept as small as possible.
- .5 Review relevant shop drawings and product data of other Divisions where they affect the work of this Section, prior to commencing the work.

3.2 DELIVERY AND STORAGE

- .1 Store materials and equipment delivered to the site and pending installation in a safe, dry and heated location, protected against dust weather, damage, corrosion and theft.
- .2 Remove rejected material and equipment from the site immediately.
- .3 Touch up damage to factory finishes to the DCC Representative's satisfaction. Use finishes to match existing. Do not paint over nameplates or labels.

3.3 PROTECTION

- .1 Take precautions to protect personnel on the job site from injury due to live equipment and circuits. Shield and clearly mark all such circuits or equipment "DANGER – LIVE 208 VOLTS" or the applicable voltage.
- .2 Arrange for installation of temporary doors for rooms containing electrical distribution equipment. Keep these doors locked except when under direct supervision of electrician.
- .3 Adequately protect concrete floors and finished flooring from damage. Take special measures when moving heavy loads or equipment.
- .4 Keep floors free from oils, grease or other materials likely to discolour them or affect bond of applied surfaces.
- .5 Attach and fasten fixtures and fittings in place in a safe, sturdy, secure manner so that they cannot work loose, fall or shift out of position during normal use of the building.
- .6 Protect all finished and unfinished work of this and other Divisions from damage due to carrying out of this work.
- .7 Be responsible for and make good any damage caused directly or indirectly by this contractor to walls, floors, ceilings, woodwork, brickwork, finishes, existing installations etc.
- .8 Protect all temporarily installed electrical equipment from damage so that it may be re-used for the permanent installation.

3.4 CUTTING AND PATCHING

- .1 Provide all holes and chases required for the electrical work.
- .2 Obtain approval of the DCC Representative prior to cutting or drilling any structural elements.
- .3 Patching is specified under General Work.

3.5 WORKMANSHIP

- .1 Perform the work in a neat and careful manner so that items are and will remain plumb, square and straight. Ensure that materials and equipment are free from warp, twist or other defects.
- .2 Unless specified otherwise, install products in strict accordance with manufacturer's written instructions and recommended usage.

- .3 Workmanship shall be of a high standard throughout, as detailed below and/or in other Sections of the Specifications.
 - .1 Exposed conduit runs including runs in ceiling spaces shall be parallel to the building lines. Panels, boxes, covers, etc. shall be mounted in a similar manner. These conditions shall be determined using spirit levels.
 - .2 Bolts or nuts in a “stripped” or “cross threaded” condition shall be replaced immediately.
 - .3 Avoid connection between dissimilar metals and use of corrosive material in wet or damp locations.
 - .4 Conceal all electrical rough-in in all areas except where surface installations are specifically indicated. Where this becomes impossible, obtain ruling from DCC Representative as to determine what adjustments are to be made before proceeding with work.

3.6 EQUIPMENT IDENTIFICATION

- .1 Fasten lamacoid nameplates to equipment with self-tapping screws.
- .2 Colour code conduit, outlets, pull and junction boxes as specified in Part 2 of this Section. Junction boxes in exposed areas shall not have sharpie markings on exterior of box with circuit information. Label inside of box cover with circuit and panelboard numbers. Outside of box shall be colour coded in accordance with Part 2 of this section.
- .3 Identify wiring with permanent markers as specified in Part 2 of this Section.

3.7 LOCATION OF OUTLETS

- .1 Do not install outlets back-to-back; allow minimum 150 mm horizontal clearance between boxes.
- .2 Locate light switches on latch side of doors. Locate disconnect devices in mechanical and elevator machine rooms on latch side of floor.
- .3 Vertically align outlets of different systems when shown in close proximity to each other and occurring at different mounting heights.
- .4 Change location of outlets at no extra cost or credit, providing distance does not exceed 3000 mm, and information is given before installation.

3.8 MOUNTING HEIGHTS

- .1 Mounting height of equipment is from finished floor to centerline of equipment unless otherwise specified or indicated.
- .2 If mounting height of equipment is not indicated, verify before proceeding with installation.
- .3 Install electrical equipment at the following heights (to centerline of device) unless indicated otherwise on plans or elevations etc.:
 - .1 Local Switches: 1400 mm A.F.F.
 - .2 Wall Receptacles:
 - .1 General: 300mm A.F.F.
 - .2 Shops: 610 mm A.F.F. or other mounting height as indicated on drawings
 - .3 Above Top of Counters or Splashback: 175 mm or as specified on architectural drawings
 - .4 In Mechanical Rooms: 1400 mm A.F.F.
 - .5 Welding receptacles and disconnect switches: refer to drawing model

- .3 Panelboards: As required by code or as indicated.
- .4 Telephone & Data Outlets: 400 A.F.F.
- .5 High Wall Mounted Telephone and Data Outlets: 1500 mm A.F.F.
- .6 Fire Alarm Stations: 1500 mm A.F.F.
- .7 Fire Alarm Horns/Strobes: 2100mm A.F.F. and minimum 150mm below ceiling
- .8 Fire Alarm E.O.L. devices: 1800 mm A.F.F.
- .9 Thermostats: 1500 mm
- .10 Hand Dryers- Barrier Free: per manufacturer recommendation
- .11 Hand Dryers: 900 mm A.F.F.
- .12 Emergency remote heads and battery packs: refer to drawing model

3.9 CLEANING

- .1 Do final cleaning in accordance with the General Conditions and, specifically, as follows:
 - .1 Clean lighting fixture reflectors, lamps, lenses and other lighting surfaces that have been exposed to construction dust and dirt.
 - .2 Remove debris and vacuum clean within panelboard tubs, terminal cabinets and electric heating fixtures.
 - .3 Remove electrical waste and debris from the site.

3.10 CARE, OPERATION AND START-UP

- .1 Refer to Sections 26 57 01, 26 57 02 and 26 57 03.

3.11 TESTS AND INSPECTIONS

- .1 Refer to Sections 26 57 01, 26 57 02 and 26 57 03.

3.12 SEISMIC CONSIDERATIONS

- .1 Comply with all pertinent Code requirements.
- .2 The objective in providing seismic restraint is to provide for a reasonable level of life safety by concentrating the efforts on restraining heavy equipment in place, maintaining essential life safety related systems and protecting the escape routes from the building.
- .3 Electrical equipment and associated services requiring seismic restraints shall include but not necessarily be limited to the following items. Compare with the drawings and add to the list as applicable:
 - .1 Equipment:
 - .1 All floor mounted, static electrical equipment including but not necessarily limited to the following, shall be suitable anchored and braced to ensure that it does not topple over:
 - .1 Floor mounted panelboards
 - .2 Control Panels
 - .3 Transformers
 - .2 All floor mounted electrical equipment with moving parts shall be anchored and provided with vibration isolator and snubber assemblies.
 - .2 Life safety related systems:

- .1 Systems that must be operational, to provide an appropriate level of safety in evacuating the building are considered to be:
 - .1 Fire Alarm System.
 - .2 Emergency Lighting Systems.
- .2 For these systems, the following considerations apply:
 - .1 Equipment must be installed in accordance with the criteria indicated above.
 - .2 Conduit installations for these systems will generally be installed securely on the slab, with expansion couplings to cross building joints and where these are terminated into equipment that is likely to vibrate or move, the connection is to be in flexible conduit.
 - .3 To maintain the continuity of Fire Alarm system, suitable materials and methods to provide fire rating as well as seismic restraint are required.
- .4 Escape route considerations: To maintain accessibility in escape routes, the pertinent electrical installations must be seismically restrained.

END OF SECTION

Part 1 General

1.1 REFERENCES

- .1 CSA C22.2 No. 65-2018-Wire connectors (Trinational standard with NMX-J-543-ANCE and UL 486A-486B)
- .2 EEMAC 1Y-2, 1961 Bushing Stud Connectors and Aluminum Adapters (1200 Ampere Maximum Rating).

Part 2 Products

2.1 MATERIALS

- .1 Pressure type wire connectors: with current carrying parts of copper sized to fit copper conductors as required.
- .2 Fixture type splicing connectors: with current carrying parts of copper sized to fit copper conductors 10 AWG or less.
- .3 Bushing stud connectors: to EEMAC 1Y-2 to consist of:
 - .1 Connector body and stud clamp for stranded or round copper conductors, tube, or bar.
 - .2 Clamp for stranded or round copper conductors or bar.
 - .3 Stud clamp bolts.
 - .4 Bolts for copper conductors or bar.
 - .5 Sized for conductors, tubes or bars as indicated.
- .4 Clamps or connectors for armoured cable, mineral insulated cable, flexible conduit, as required.

Part 3 Execution

3.1 INSTALLATION

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

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

- .1 Section 26 05 43.01 – Installation of Cables in Trenches and Ducts.
- .2 Section 26 05 34 – Conduits, Conduit Fastenings and Conduit Fittings.
- .3 Section 26 05 20 – Wire and Box Connectors.

1.2 REFERENCES

- .1 CSA C22.2 No. 0.3-09 (R2014), Test Methods for Electrical Wires and Cables.

1.3 PRODUCT DATA

- .1 Submit product data in accordance with Section 26 05 00 – Common Work Results for Electrical.

Part 2 Products

2.1 BUILDING WIRES

- .1 Conductors: stranded for 10 AWG and larger as required by DND. Minimum size: 12 AWG.
- .2 Copper conductors type RW90: Size as indicated, with 600 V insulation to maximum #10 AWG and 1000V for #8 AWG and larger, or chemically cross-linked thermosetting polyethylene material (XLPE) insulation.
- .3 Copper conductor type T90 may be used as an alternate to type RW90 up to 600V.
- .4 Branch circuit wiring:
 - .1 Wiring for branch circuits shall be sized to limit the voltage drop from the Panelboard to the farthest outlet/fixture to 2% when carrying 80% of the branch circuit breaker rated current.
 - .2 For 120 volt circuits using shared neutrals, minimum wire sizes shall be:
 - .1 #12 AWG for runs up to 30 m.
 - .2 #10 AWG for runs in excess of 30 m up to a distance that ensures compliance with item 1.3.1 above. #10 AWG shall be used for the entire length of run, starting from the protection device.
 - .3 All shared neutrals shall be oversized, #10 AWG or larger for #12 AWG phase conductors. This applies to power as well as lighting circuits.
 - .4 The shared neutrals shall be oversized, #8 AWG or larger for #10 AWG phase conductors. This applies to power as well as lighting circuits.
 - .3 For 120 volt circuits, using separate neutrals, minimum wire sizes shall be:
 - .1 #12 AWG for runs up to 21 m.
 - .2 #10 AWG for runs in excess of 21 m up to a distance that ensures compliance with item 1.3.1 above. #10 AWG shall be used for the entire length of run, starting from the protection device.
 - .4 For 347 volt lighting circuits, minimum wire sizes shall be:
 - .1 #12 AWG for runs up to 90 m.

- .2 #10 AWG for runs in excess of 90 m up to a distance that ensures compliance with item 1.3.1 above. #10 AWG shall be used for the entire length of run, starting from the protection device.
- .3 All shared neutrals shall be oversized, #10 AWG or larger for #12 AWG phase conductors.
- .4 The shared neutrals shall be oversized, #8 AWG or larger for #10 AWG phase conductors.
- .5 Voltage drop limits for fixed loads and feeders have been accounted for on the drawings.
- .5 Underground Wiring:
 - .1 Type RWU-90 for all underground wiring and to padmounted transformers and other exterior underground installations such as site lighting, etc.
- .6 Pressure type connectors, fixture type splicing connectors, cable clamps as required.

2.2 ARMoured CABLE

- .1 Conductors: copper based on the same criteria as for Building Wires.
- .2 Type: AC90
 - .1 Armour: interlocking type fabricated from galvanized steel or aluminum strip.
- .3 Type: ACWU90
 - .1 Armour: interlocking type fabricated from galvanized steel or aluminum strip.
 - .2 ACWU90-PVC flame retardant jacket over armour meeting requirements of Vertical Tray Fire Test of CSA C22.2 No. 0.3 with maximum flame travel of 1.2m. Minus 25°C or minus 40°C rating.
Note: FT rating shall be as required by authorities having jurisdiction and applicable codes.
- .4 Connectors: To manufacturer's recommendations.

2.3 TECK 90 CABLE

- .1 Cable: in accordance with Section 26 05 00 - Common Work Results for Electrical.
- .2 Conductors:
 - .1 Grounding conductor: copper.
 - .2 Circuit conductors: copper, size as indicated.
- .3 Insulation:
 - .1 Cross-linked polyethylene XLPE.
 - .2 Rating: 600 V.
- .4 Inner jacket: polyvinyl chloride material.
- .5 Armour: interlocking galvanized steel.
- .6 Overall covering: thermoplastic polyvinyl chloride.
- .7 Fastenings:
 - .1 One hole steel straps to secure surface cables 50 mm and smaller. Two hole steel straps for cables larger than 50 mm.
 - .2 Channel type supports for two or more cables at 50 mm centers.

- .3 Threaded rods: 6 mm diameter to support suspended channels.
- .8 Connectors:
 - .1 Watertight, approved for TECK cable.

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
 - Note: All wiring shall be in conduit unless specifically indicated otherwise.
 - Note: Cables in open cable tray and ceiling spaces shall be FT rated to the requirements of the code and authorities having jurisdiction. Generally cables installed in return air plenums must carry an FT6 classification where such cables are multiple conductors. The given cables must provide a flame spread rating of not more than 25. Plenum spaces that do not function as return air plenums can be equipped with FT4 classification cables.
 - .2 In trenches and underground ducts in accordance with Sections 26 05 43.01 and 33 65 76.
- .2 Type T-90 will not be permitted in lieu of RW-90.
- .3 Minimum branch circuit conductors shall be #12 AWG except for 120 volt control circuits, minimum size of wire shall be #14 AWG. Wire sizes shown on the drawings are based on the ampacities of copper conductors with RW-90 insulation. Where alternative types of wire are permitted adjust wire sizes for equivalent ampacities to RW-90 of the size indicated.
- .4 Length of conductors at outlets for connection to devices to be not less than 200 mm.
- .5 Make joints or splices only within boxes. Do not pull splices into conduit.

3.2 INSTALLATION OF ARMoured CABLES

- .1 Group runs of AC-90. Do not bundle.
- .2 Install cable in trenches in accordance with Section 26 05 43.01.
- .3 Terminate cables in accordance with Section 26 05 20 - Wire and Box Connectors.
- .4 Type AC-90 will be permitted only from:
 - .1 Raceway system junction boxes to individual recessed lighting fixtures in suspended, accessible ceilings. Single run to each lighting fixture, max. 5.0 metre lengths. Do not loop from fixture to fixture.
 - .2 Raceway system junction boxes above suspended accessible ceilings to outlets in hollow gypsum board partitions (max. 10metres lengths).
 - .3 AC-90 will not be permitted in masonry or concrete walls.

3.3 INSTALLATION OF SINGLE CONDUCTOR ARMoured AND TECK CABLES

- .1 Space or group cables in accordance with the recommendations of the manufacturer.
- .2 Install non-magnetic and insulating type plates at all cable termination points. At supply points connectors shall be fitted with a grounding system bushing and a No. 6 copper conductor installed to ground supply end of cable sheath to grounding media.
 - Note: Ground cable sheath at supply end only for single conductor cables.

- .3 At load end of cable install a non-metallic plate into which the single conductor cables shall terminate. Non-metallic plates 12 mm fibreboard securely bolted over opening cut in enclosure.

3.4 GENERAL WIRING INSTALLATION REQUIREMENTS

- .1 Colour Coding:
 - .1 Colour code throughout building, same colour for same phase throughout, by insulation colour or permanently applied colour banding at all distribution centres, panels and outlet boxes.
 - .2 Colour code to be as follows:
 - .1 Equipment grounding conductor: green
 - .2 Neutral conductor: white
 - .3 Standard 120/208 V phase wires: red, black and blue
 - .4 Standard 347/600 V phase wires: orange, brown and yellow
- .2 Replace at no cost to Owner any wire or cable that does not meet insulation testing.
- .3 Wiring – Fire Resistance Ratings:
 - .1 Use wiring materials and methods to provide the required fire resistance ratings as called for by the National Building Code and the Ontario Building Code for all pertinent applications including but not necessarily limited to the following:
 - .1 Fire Alarm
 - .2 Sprinkler Systems monitoring
 - .3 Life safety power

3.5 TESTING AND COMMISSIONING

- .1 Carry out testing and commissioning in accordance with Section 26 57 01, 26 57 02 and 26 57 03.

END OF SECTION

Part 1 General

1.1 REFERENCES

- .1 Grounding to CSA C22.1 – Ontario Electrical Safety Code.
- .2 Grounding equipment to CSA C22.2 No. 41.
- .3 Copper ground conductors to CSA G7.1-1964.

Part 2 Products

2.1 EQUIPMENT

- .1 Rod Electrodes: copper clad steel, 19mm by 3.0 m long.
- .2 Underground conductors: Base, stranded, untinned, soft annealed copper wire size #4/0 AWG for interconnecting ground grid, rod electrodes, for grounding structural steel, unless indicated otherwise.
- .3 Conductors: PVC insulated green stranded, untinned, soft annealed copper wire, sizes as indicated for all above ground installations.
- .4 Ground bus: Copper, minimum size 6 mm by 50 mm by length as indicated, complete with insulated supports, fastenings and connectors.
- .5 Clamps and lugs: Sizes as required to suit conductor sizes.
- .6 Non-corroding accessories necessary for grounding system, type, size, material as indicated, including but not necessarily limited to:
 - .1 Grounding and bonding bushings.
 - .2 Protective type clamps.
 - .3 Bolted type conductor connectors.
 - .4 Thermite welded type conductor connectors.
 - .5 Bonding jumpers, straps.
 - .6 Pressure wire connectors.

Part 3 Execution

3.1 INSTALLATION GENERAL

- .1 Install complete permanent, continuous, system and circuit, equipment, grounding systems including ground grid, electrodes, conductors, connectors, accessories, as indicated, to conform to requirements of DCC Representative, and local authority having jurisdiction over installation.
- .2 Ground wires shall be installed for all branch circuits and motor circuits by running the ground wires in the same conduit as follows:
 - .1 For branch circuits using shared neutrals, install one ground wire per neutral.
 - .2 For circuits using individual neutrals for each circuit, use one ground wire per circuit.
 - .3 Minimum size of ground wire to be #12 AWG copper.

- .3 Install continuous grounding conductors through all metallic and non-metallic raceways and outlets for systems operating above 50 volts, bond at each box and device.
- .4 Install equipment to manufacturer's specifications.
- .5 Protect exposed grounding conductors from mechanical injury.
- .6 Make buried connections, and connections to conductive water main and electrodes using copper welding by thermite process.
- .7 Soldered joints are not permitted.
- .8 Use mechanical connectors for grounding connections to equipment provided with lugs.
- .9 Ground all transformer secondary neutrals and enclosures as indicated or back to primary feeder distribution panel ground, where not specifically indicated.
- .10 Install ground grid and rod electrodes as indicated and make grounding connections.
- .11 Bond single conductor; metallic armoured cables to supply side cabinet by means of conductive plate. Provide a non-conductive plate at the load end.
- .12 Ground all metallic raceways for systems including fire alarm, telephone, door entry, cablevision, voice and data systems.
- .13 Install bonding wire for flexible conduit, connected at both ends to grounding bushing, solderless lug, clamp or cup washer and screw. Neatly cleat bonding wire to exterior of flexible conduit.
- .14 Install flexible ground straps for bus duct enclosure joints, where such bonding is not inherently provided with equipment.
- .15 Install separate ground conductor to outdoor lighting standards.
- .16 Connect building structural steel and metal siding to ground bus by welding copper to steel.
- .17 Make grounding connections in radial configuration only, with connections terminating at single grounding point. Avoid loop connections.

3.2 MAINTENANCE HOLES

- .1 Install conveniently located grounding stud, electrode, size 2/0 AWG stranded copper conductor in each maintenance hole.
- .2 Install ground rod in each maintenance hole so that top projects through bottom of maintenance hole. Provide with lug to which grounding connection can be made. Confirm ground resistance meets or exceeds Canadian Electrical Code minimum requirements.

3.3 ELECTRODES

- .1 Install additional electrodes where indicated or required in building foundation footings, with terminals connected to grounding network.
- .2 Install additional rod electrodes where indicated or required and make grounding connections.
- .3 Bond separate, multiple electrodes together.
- .4 Use size 4/0 AWG copper conductors for connections to electrodes.
- .5 Make special provision for installing electrodes that will give acceptable resistance to ground value where rock or sand terrain prevails. Ground as indicated.

3.4 SYSTEM AND CIRCUIT GROUNDING

- .1 Install system and circuit grounding connections to systems as required by code.

3.5 EQUIPMENT GROUNDING

- .1 Install grounding connections to typical equipment included in, but not necessarily limited to following list: Service equipment, transformers, duct systems, frames of motors, starters, control panels, building steel work, distribution panels, outdoor lighting, etc.

3.6 GROUNDING BUS

- .1 Ground equipment installed in Electrical room and IT room to ground bus with individual bare stranded copper connections size 2/0 AWG.

3.7 COMMUNICATION SYSTEMS

- .1 Install grounding connections for data, telephone and fire alarm systems as indicated on drawings.

3.8 TESTING AND COMMISSIONING

- .1 Carry out Testing and Commissioning in accordance with Section 26 57 01, 26 57 02 and 26 57 03.
- .2 Ground rods to be resistance tested in reference to earth and not be more than 25 ohms.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

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

Part 2 Products

2.1 SUPPORT CHANNELS

- .1 U shape, size 41 x 41 mm, 2.5 mm thick, surface mounted or suspended.

Part 3 Execution

3.1 INSTALLATION

- .1 Use lead anchors to secure equipment to solid masonry, tile and plastic surfaces.
- .2 Use expandable inserts to secure equipment to poured concrete.
- .3 Use toggle bolts to secure equipment to hollow masonry walls or suspended ceilings.
- .4 Secure surface mounted equipment and devices with twist clip fasteners to inverted T-bar ceilings. Ensure that T-bars are adequately supported to carry weight of equipment and devices specified before installation. Heavier equipment, such as light fixtures, are to be supported from the roof structure.
- .5 Support groups of conduits and cables, and equipment on 41 mm x 41 mm x 2.5 mm thick galvanized channels using clips, spring loaded bolt, cable clamps and the like, designed as accessories to basic channel members. Support channels on 6 mm threaded rod hangers where direct fastening to building structure is impractical.
- .6 For surface mounting of two or more conduits use channels at 1.5 mm or less on centre spacing.
- .7 Fasten exposed conduit or cable to building construction or support systems as follows:
 - .1 One-hole steel strap for 50 mm and smaller.
 - .2 Two-hole steel strap for larger than 50 mm.
 - .3 Beam clamps to secure conduit to exposed steelwork.
- .8 Perforated straps and twisted wire lashing to support or secure raceways or cables will not be accepted.
- .9 Do not use supports or equipment installed for other trades for conduit or cable supports except with the permission of other trades and approval of the DCC Representative.
- .10 Install support structures to maintain head room and neat mechanical appearance, and to support equipment loads.

Provide metal brackets, frames, hangers, clamps and related types of support structures where indicated or as required to support conduit and cable runs.
- .12 Ensure adequate support for raceways and cables dropped vertically to equipment where there is no wall support.
- .13 Install fastenings and supports as required for each type of equipment cables and conduits, and in accordance with manufacturer's installation recommendations.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

- .1 Section 26 05 34 – Conduits, Conduit Fastenings and Conduit Fittings.
- .2 Section 26 27 26 – Wiring Devices.

1.2 REFERENCES

- .1 CSA C22.1 – Canadian Electrical Code and Ontario Electrical Safety Code (latest edition).

Part 2 Products

2.1 OUTLET AND CONDUIT BOXES GENERAL

- .1 Size boxes in accordance with CEC/OESC
- .2 102 mm square or larger outlets boxes as required for special devices.
- .3 Gang boxes where wiring devices are grouped.
- .4 347 V outlet boxes for 347 V switching devices.
- .5 Blank cover plates for boxes without wiring devices.
- .6 Combination boxes with barriers where outlets for more than one system are grouped.
- .7 Surface mounted outlet boxes in dust prone areas to be dust-tight cast metal boxes without openings after conduits are installed. Cover plates and receptacle covers to be sealed gasketed type. Conduits to be terminated to electrical box using threaded hubs with dust-tight or liquid-tight fittings.
- .8 Surface mounted outlet boxes in wet location and water prone areas to be Nema 3R rated. Areas subject to hosedown and water spray to be water-tight Nema 4X rated. Conduits to be terminated to electrical box using threaded hubs with liquid-tight fittings.
- .9 Conduit, box and wiring installations in classified spaces shall be specified and installed in accordance with CEC C22.1, Section 18 (latest edition).

2.2 SHEET STEEL OUTLET BOXES

- .1 Electro-galvanized steel single and multi gang flush device boxes for flush installation, minimum size 76 x 50 x 38 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 Electro-galvanized steel 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.
- .4 102 mm square outlet boxes with extension and plaster rings for flush mounting devices in finished plaster walls.

2.3 OUTLET BOXES FOR TELEPHONE AND DATA OUTLETS

- .1 Telephone and Data Outlets: 100 x 100 x 54 mm outlet box complete with plaster ring.

2.4 MASONRY BOXES

- .1 Electro-galvanized steel masonry single and multi gang boxes for devices flush mounted in exposed block walls.

2.5 CONCRETE BOXES

- .1 Electro-galvanized sheet steel concrete type boxes for flush mount in concrete with matching extension and plaster rings as required.

2.6 CONDUIT BOXES

- .1 Cast FS or FD ferroalloy boxes with factory-threaded hubs and mounting feet for surface wiring of switches and receptacles.

2.7 VAPOUR BARRIER BOX

- .1 Standard of Acceptance:
 - .1 Liteline Vapor Barrier
 - .2 ABB/Iberville Vapor Barrier
 - .3 Hubbell Vapor Barrier

2.8 FITTINGS - GENERAL

- .1 Bushing and connectors with nylon insulated throats.
- .2 Knock-out fillers to prevent entry of debris.
- .3 Conduit outlet bodies for conduit up to 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 Outlets, which occur at the same general location, are to be installed as a symmetric group with centres aligned either vertically or horizontally.
- .5 Install knockout fillers in unused openings.
- .6 Identify circuit numbers on junction box covers using black marker.
- .7 Color code electrical boxes to differentiate between normal/emergency power, voltage, fire alarm, communications, etc. in accordance with section 26 05 00.
- .8 Provide correct size of openings in boxes for conduit, mineral insulated and armoured cable connections. Reducing washers are not allowed.

- .9 Junction boxes in exposed areas shall not have sharpie markings on exterior of box with circuit information. Label inside of box cover with circuit and panelboard numbers. Outside of box shall be colour coded in accordance with section 26 05 00.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

- .1 Section 26 05 29 – Fastenings and Supports.
- .2 Section 26 05 21 – Wires and Cables (0-1000V).

1.2 REFERENCES

- .1 Canadian Standards Association (CSA):
 - .1 CAN/CSA C22.2 No. 18.1-13, Outlet Boxes.
 - .2 CAN/CSA C22.2 No. 18.2-2006(R2011) Non-Metallic Outlet Boxes.
 - .3 CAN/CSA C27.2 No. 18.3-2012 Conduit, Tubing and Cable Fittings.
 - .4 CSA C22.2 No. 45.1-07(R2012) Electrical Rigid Metal Conduit – Steel.
 - .5 CAN/CSA C22.2 No. 45.2-08(R2013) Electrical Rigid Metal Conduit – Aluminum Red Brass and Stainless Steel.
 - .6 CSA C22.2 No. 56-04(R2009), Flexible Metal Conduit and Liquid-Tight Flexible Metal Conduit.
 - .7 CSA C22.2 No. 83.1-07(R2012), Electrical Metallic Tubing.
 - .8 CSA C22.2 No. 211.2-06(R2011), Rigid PVC Conduit.
 - .9 CAN/CSA C22.2 No. 227.2.1-14, Liquid Tight Flexible Nonmetallic Conduit.

Part 2 Products

2.1 GENERAL

- .1 Surface mounted conduit installation in dust prone areas to be dust-tight using rigid metal conduit with dust-tight threaded couplings and hubs or EMT with dust-tight or liquid-tight fittings.
- .2 Surface mounted conduit installation in wet location and water prone areas to be water-tight using rigid metal conduit with liquid-tight threaded couplings and hubs or EMT with liquid-tight fittings.
- .3 Conduit, box and wiring installations in classified spaces shall be specified and installed in accordance with CEC C22.1, Section 18 (latest edition).

2.2 CONDUITS

- .1 Rigid metal conduit: Zinc-coated steel, galvanized, with reamed ends, manufactured in accordance with CSA 22.2 No. 45.
 - .1 Couplings: Threaded rigid galvanized steel.
 - .2 Bushings: Insulated throat, grounding type. All connections to be threaded.
- .2 EMT: Steel galvanized with reamed ends, manufactured in accordance with CSA 22.2 No. 83.
 - .1 Couplings: Zinc coated steel setscrew type.
 - .2 Connectors: Zinc coated steel set screw type with nylon insulated throats.
 - .3 Watertight couplings and connectors in access floors, areas exposed to sprinklers and in damp/humid areas.

- .3 Rigid PVC heavy wall conduit with solvent weld fittings, coupling and adapters. Wall thicknesses shall be minimum:

Size	Wall Thickness
20 mm	3.38 mm
32 mm	3.56 mm
38 mm	3.68 mm
50 mm	3.91 mm
75 mm	5.49 mm
100 mm	6.02 mm

- .4 Electrical nonmetallic tubing (ENT) with compatible manufactured couplings and connectors.
- .5 Flexible metal conduit: To CSA C22.2 No. 56, and as follows:
- .1 Flexible metal conduit: Spirally wound, interlocked zinc coated strip steel, minimum 20 mm diameter, except for lighting fixture and control connections where minimum 12 mm diameter is permitted.
- .2 Flexible metal conduit fittings: Threadless hinged clamp style.
- .6 Liquid-tight flexible metal conduit:
- .1 Continuous interlocked and double-wrapped steel, zinc coated inside and outside, coated with liquid-tight jacket of flexible PVC, minimum 20 mm diameter.
- .2 Liquid-tight flexible metal conduit fittings: Cadmium plated, malleable iron fittings with compression type steel ferrule and neoprene gasket sealing rings.
- .7 Rigid aluminum conduit for ground conductors. Fittings same material as conduit.
- .8 Miscellaneous fittings: Locknuts, bushings, reducers, chase nipples, 3-piece unions, split couplings, plugs and expansion fittings specifically designed for their particular application.
- .9 The minimum conduit size shall be 20 mm, except where noted otherwise.

2.3 CONDUIT FASTENINGS

- .1 One-hole steel straps to secure surface conduits 50 mm and smaller. Two-hole steel straps for conduits larger than 50 mm.
- .2 Beam clamps to secure conduits to exposed steel work.
- .3 Channel type supports for two or more conduits at 1.5 m on centre.
- .4 Minimum 6 mm. dia. threaded rods to support suspended channels.
- .5 Perforated steel strapping, tie wire and/or field fabricated hangers or supports will not be permitted.

2.4 CONDUIT FITTINGS

- .1 Fittings: manufactured for use with conduit specified. Coating: same as conduit.
- .2 Factory “ells” where 90° bends are required for 25 mm and larger conduits.

2.5 EXPANSION FITTINGS FOR CONDUITS

- .1 Weatherproof expansion fittings with internal bonding assembly suitable for 100 mm linear expansion.
- .2 Watertight expansion fittings with integral bonding jumper suitable for linear expansion and 19 mm deflection in all directions.

- .3 Weatherproof expansion fittings for linear expansion at entry to panel.
- .4 Install approved expansion fittings in all conduit runs which cross the structural expansion joints of the building.

2.6 FISH CORD

- .1 Polypropylene, minimum 180 kg. pull strength.

Part 3 Execution

3.1 INSTALLATION

- .1 Install conduits to conserve headroom in exposed locations and cause minimum interference in spaces through which they pass.
- .2 Conceal raceway in all areas except in mechanical and electrical rooms, or where otherwise indicated.
- .3 Install EMT throughout except where specified otherwise.
- .4 Install threaded, rigid, galvanized steel conduit in Class I, II and III hazardous locations. Manufactured conduit sealing fittings shall be provided, and these shall be filled with sealing compound shall be after conductors are drawn in. Installation shall be in accordance with CEC C22.1, Section 18 (latest edition).
- .5 Install rigid aluminum conduit for ground conductors which are run separate from feeder conductors.
- .6 In damp locations slope raceway to provide drainage.
- .7 Use flexible galvanized steel conduit minimum 600 mm and maximum 1000 mm length for connections to equipment which may vibrate (such as transformers or equipment with motors), and to equipment not permanently fixed or which must be moved for servicing.
- .8 Install liquid-tight flexible metallic conduit for applications described in 3.1.8 in damp or corrosive locations.
- .9 Bend conduit cold. Replace conduit if kinked or flattened more than 1/10th of its original diameter. Radius of the inner edge of the conduit shall comply with the OESC but shall not be less than 600 mm under any circumstances.
- .10 Mechanically bend steel conduit over 20 mm dia.
- .11 Field threads on rigid conduit must be of sufficient length to draw conduits up tight.
- .12 Install CSA approved expansion fittings, complete with grounding jumpers, where conduits cross building expansion joints. Provide bend or offset in conduit adjacent to building expansion joint where conduit is installed above suspended ceilings.
- .13 Where conduits pass through fire separating floors, ceilings or walls, close off space between conduit with tight fitting metal caps on both sides and non-combustible insulation. Caulk to the approval of the DCC Representative and authorities having jurisdiction.
- .14 Under no circumstances shall conduits be installed surface mounted across an open floor area.
- .15 Take into account the applicable seismic requirements when installing conduits, especially where conduits cross building joints.
- .16 Remove and replace blocked conduit sections. Do not use liquids to clean out conduits.

- .17 Ream raceway ends to remove burrs.
- .18 Clean out and dry conduits. Seal both ends to prevent ingress of foreign materials, dirt and moisture.
- .19 Raceway systems shall be completely installed, and dry and clean, before pulling conductors.
- .20 Install polypropylene, minimum 180 kg. Pull strength pull cords in empty raceway and fasten cords at each end.
- .21 Provide factory “ELLS” for 90° bends in raceways larger than 25 mm.
- .22 Use rigid PVC conduits underground and in concrete slab.
- .23 DO NOT USE CONDUIT AS GROUND. Provide separate ground conductor in each conduit.

3.2 SURFACE CONDUITS

- .1 Run parallel or perpendicular to building lines.
- .2 Locate conduits behind infrared or gas fired heaters with 1.5 m clearance.
- .3 Run conduits in flanged portion of structural steel.
- .4 Group conduits wherever possible on suspended and/or surface channels.
- .5 Do not pass conduits through structural members except as indicated.
- .6 Do not locate conduits less than 150 mm parallel to steam or hot water lines with minimum of 25 mm at crossovers.
- .7 Do not locate conduits less than 150 mm parallel to exhaust pipes, with minimum of 150 mm at crossovers.

3.3 CONCEALED CONDUITS

- .1 Run parallel or perpendicular to building lines in all cases e.g., in ceiling spaces and in walls, etc.
- .2 Install raceway in masonry walls during construction of such walls. Do not install runs horizontally in masonry walls.
- .3 Do not install conduits in terrazzo or concrete toppings.

3.4 CONDUITS IN-CAST-IN PLACE CONCRETE

- .1 Plan conduit runs and obtain the approval of Structural Engineer.
- .2 Space conduit runs six conduit diameters apart.
- .3 Avoid crossing conduit runs. Where crossings can not be avoided, the crossing conduit shall run perpendicular to each other.
- .4 No conduit shall pass over a column, end of a shear wall or column capital. Avoid drop panels.
- .5 Generally run conduit in the slab “middle strips” which are indicated on the structural drawings. Coordinate with Jp2g’s Structural Engineer.
- .6 Do not tie conduit run directly over a reinforcing bar in the same direction, as this would reduce concrete bond. Locate conduit runs between parallel reinforcing bars.
- .7 Exercise great care at hubs such as electrical and communication rooms. Obtain specific approval of Structural Engineer of the proposed installation plan.
- .8 Protect conduits from damage where they stub out of concrete.

- .9 Do not place conduits in slab in which slab thickness is less than four (4) times conduit diameter.
- .10 Install sleeves where conduits pass through slab or wall.
- .11 Provide oversized sleeve for conduits passing through waterproof membrane, before membrane is installed. Use cold mastic between sleeve and conduit.
- .12 Guidelines for penetrations and sleeves through concrete slabs and walls are as follows:
 - .1 Sleeves may not pass through column capitals or within eight sleeve diameters of columns or end walls unless specifically approved by the Structural Engineer and/or indicated on structural drawings.
 - .2 Sleeves must not disrupt “bottom integrity” reinforcing steel, which runs between columns/walls.
 - .3 As far as possible, locate sleeves within the “middle strips” of the slab or along the side (not end) of shear walls.
 - .4 Space sleeves a minimum of four sleeve diameters apart.

3.5 CONDUITS IN-CAST-IN-PLACE SLABS ON GRADE

- .1 Run 25 mm and larger below slab and encased in 75 mm concrete envelope. Provide 50 mm of sand over concrete envelope below floor slab.

3.6 CONDUITS UNDERGROUND

- .1 Slope conduits to provide drainage.
- .2 Waterproof joints (PVC excepted) with heavy coat of bituminous paint.
- .3 All underground conduits shall be encased in minimum 75 mm concrete all around.

3.7 COORDINATION

- .1 Coordinate conduit installations with the work of other trades and related electrical installations including wire and cable, boxes and fittings, panels, etc. Ensure clear access to junction boxes.
- .2 Coordinate installation of conduit in concrete.
- .3 Coordinate installation of conduit in masonry.
- .4 Coordinate installation of conduit which penetrates fire rated walls, floors or ceilings with firestopping work specified in Division 1. Ensure that integrity of the fire rated element is maintained.

END OF SECTION

Part 1 General

1.1 REFERENCES

- .1 Insulated Cable Engineers Association, Inc. (ICEA)
- .2 American National Standards Institute (ANSI) / International Electrical Testing Associate (NETA)
 - .1 ANSI/NETA ATS-2013, Standard for Acceptance Testing Specifications for Electrical Power Equipment and Systems.

Part 2 Products

2.1 WARNING TAPE

- .1 Plastic, red coloured with black lettering, to run entire length of duct bank and to be full width of trench.

Part 3 Execution

3.1 CABLE INSTALLATION IN DUCTS

- .1 Install cables as indicated in ducts.
- .2 Do not pull spliced cables inside ducts.
- .3 Install multiple cables in duct simultaneously.
- .4 Use CSA approved lubricants of type compatible with cable jacket to reduce pulling tension.
- .5 To facilitate matching of colour coded multi conductor control cables reel off in same direction during installation.
- .6 Before pulling cable into ducts and until cables are properly terminated, seal ends of lead covered cables with wiping solder; seal ends of non-leaded cables with moisture seal tape.
- .7 After installation of cables, seal duct ends with duct sealing compound.

3.2 FIELD QUALITY CONTROL

- .1 Perform tests in accordance with Section 26 05 00 - Common Work Results for Electrical.
- .2 Perform tests using qualified personnel.
 - .1 Include necessary instruments and equipment.
- .3 Check phase rotation and identify each phase conductor of each feeder.
- .4 Check each feeder for continuity, short circuits and grounds.
 - .1 Ensure resistance to ground of circuits is not less than 50 megohms.
- .5 Pre-acceptance tests:
 - .1 After installing cable but before splicing and terminating, perform insulation resistance test with 1000 V megger on each phase conductor.
 - .2 Check insulation resistance after each splice and/or termination to ensure that cable system is ready for acceptance testing.

- .6 Acceptance Tests:
 - .1 Ensure that terminations and accessory equipment are disconnected.
 - .2 Ground shields, ground wires, metallic armour and conductors not under test.
 - .3 High Potential (Hipot) Testing.
 - .1 Conduct hipot testing in accordance with manufacturer's recommendations.
 - .4 Leakage Current Testing:
 - .1 Raise voltage in steps from zero to maximum values as specified by manufacturer for type of cable being tested.
 - .2 Hold maximum voltage for specified time period by manufacturer.
 - .3 Record leakage current at each step.
- .7 Provide DCC Representative with list of test results showing location at which each test was made, circuit tested and result of each test.
- .8 Remove and replace entire length of cable if cable fails to meet any of test criteria.

3.3 CLEANING

- .1 Progress Cleaning: clean in accordance with the construction cleaning plan.
 - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with construction cleaning plan.
- .3 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 19 - Waste Management and Disposal.
 - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

3.4 PROTECTION

- .1 Repair damage to adjacent materials caused by cable installation.

END OF SECTION

Part 1 General

1.1 REFERENCES

- .1 CSA International
 - .1 CAN/CSA-C22.2 No.47-13, Air-Cooled Transformers (Dry Type).
 - .2 CSA C9-17, Dry-Type Transformers.
 - .3 CAN/CSA-C802.2-12, Minimum Efficiency Values for Dry Type Transformers.
- .2 National Electrical Manufacturers Association (NEMA)

1.2 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit product data in accordance with Section 26 05 00 - Electrical General Provisions.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for dry type transformers and include product characteristics, performance criteria, physical size, finish and limitations.

1.3 CLOSEOUT SUBMITTALS

- .1 Submit product data in accordance with Section 26 05 00 - Electrical General Provisions.
- .2 Operation and Maintenance Data: submit operation and maintenance data for dry type transformers for incorporation into manual.

1.4 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store materials indoors in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect dry type transformers from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.
- .4 Packaging Waste Management: remove for reuse and return of pallets, crates, padding, and packaging materials as specified in Construction Waste Management Plan.

Part 2 Products

2.1 DESIGN DESCRIPTION

- .1 Design 1.

- .1 Type: ANN.
- .2 3 phase, kVA as noted on Drawings, 600 V 3 winding Delta primary, 120/208, 3 winding Star secondary, 60 Hz, size (kVA Rating) as noted on Drawings.
- .3 Voltage taps: Four 2.5 percent full capacity taps, two above and two below normal voltage.
- .4 Insulation: Class 220, 80°C temperature rise.
- .5 Basic Impulse Level (BIL): standard.
- .6 Hipot: standard.
- .7 Average sound level: standard
- .8 Impedance at 17°C: standard.
- .9 Enclosure: CSA, removable metal front panel.
- .10 Mounting: wall or floor mounted as specified on drawings.
- .11 Finish: in accordance with Section 26 05 00 - Common Work Results for Electrical.
- .12 Copper windings.
- .13 Winding configuration to be as noted on drawings.
- .14 Voltage Regulation to be 4% or better.
- .15 Where indicated, provide K-rated transformers (K13 and K20) to withstand the harmful overheating effects caused by harmonics from non-linear loads and the neutral bus sized to accommodate 200% of the rated current.
- .16 Provide electrostatic shields between windings where indicated to reduce the coupling of surge voltages, impulses and noise between the primary and secondary windings.
- .17 Provide enclosures suitable for use in sprinklered spaces.

2.2 EQUIPMENT IDENTIFICATION

- .1 Provide equipment identification in accordance with Section 26 05 00 - Common Work Results for Electrical.
- .2 Label size: 7.

Part 3 Execution

3.1 EXAMINATION

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

3.2 INSTALLATION

- .1 Mount dry type transformers up to 50 kVA on wall.
- .2 Mount dry type transformers from 75 kVA and above on floor.

- .3 Ensure adequate clearance around transformer for ventilation.
- .4 Install transformers in level upright position.
- .5 Remove shipping supports only after transformer is installed and just before putting into service.
- .6 Loosen isolation pad bolts until no compression is visible.
- .7 Make primary and secondary connections in accordance with wiring diagram.
- .8 Energize transformers after installation is complete.
- .9 Make conduit entry into bottom 1/3 of transformer enclosure.

3.3 CLEANING

- .1 Progress Cleaning:
 - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment.
- .3 Waste Management: separate waste materials for reuse and recycling in accordance with Construction/Demolition Waste Management and Disposal Plan.
 - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

3.4 PROTECTION

- .1 Protect installed products and components from damage during construction.
- .2 Repair damage to adjacent materials caused by dry type transformers installation.

END OF SECTION

Part 1 General

1.1 SHOP DRAWINGS

- .1 Submit product data in accordance with Section 26 05 00 – Common Work Results – For Electrical.

1.2 CO-ORDINATION STUDY

- .1 Submit co-ordination study of electrical protection devices, prepared by Distribution Equipment manufacturer. The Co-ordination Study shall be carried out as soon as the Electrical Contract is awarded and the suppliers of electrical equipment selected so that the Electrical Subcontractor can ensure that all equipment ordered complies with the requirements established by the Co-ordination Study. The Co-ordination Study shall encompass the electrical distribution system for the new Pumphouse including the feeder breaker in Building #52. Any existing study already completed for Building #52 can be made available for the completion of the Study at the new Pumphouse. The Co-ordination Study shall include at least the following:
 - .1 Comprehensive fault calculations.
 - .2 Verification and selection of protection relays and determining the correct pick-up and time delay, etc., settings.
 - .3 Determine the correct settings and interrupting capacities of all protective devices.
 - .4 Correct selection and settings of motor protection.
 - .5 Determine all fuse types and sizes.
 - .6 Trip curves co-ordinated with the utility protection elements and each other.
 - .7 Ground fault protection curves, co-ordinate with each other and downstream protection elements.
 - .8 Damage curves for all equipment and cables, co-ordinate with the pertinent protective devices.
 - .9 Complete single line diagram(s) showing protective device sizes, trip settings, interrupting capacities and system fault levels.
 - .10 Prepare graphic co-ordination curves on log-log time current characteristics sheets. Prepare separate sheets for the various power distribution elements to maintain clarity. Comply also with the utility's specific requirements. Each time-current characteristic curve sheet shall include:
 - .1 A single line diagram for the pertinent portion of the system.
 - .2 The pertinent protection curves.
 - .3 The pertinent damage curves.
 - .4 The system fault level(s).
 - .5 The selected settings of the protection elements.
- .2 Co-ordination Study to recommend protective device settings and short circuit interrupting capacities which results in greatest degree of selective co-ordination.
- .3 Co-ordination Study to be submitted for approval prior to manufacture of major equipment.

1.3 SHORT CIRCUIT STUDY

- .1 Calculate the maximum short circuit currents at various locations throughout the power distribution system in the building. These locations shall include:

- .1 Main electrical service overcurrent protection device
- .2 All branch circuit breakers inside the main normal power distribution panels.
- .2 Provide time-current characteristic curves complete with one line diagrams for each calculation point.
- .3 Confirm that overcurrent protective devices are all capable of safely interrupting the maximum available fault current.
- .4 Determine let-through currents for each current limiting device.
- .5 Confirm that devices have adequate short circuit withstand capabilities.
- .6 Provide one-line diagrams indicating calculated 3-phase RMS symmetrical short circuit currents.

1.4 ARC FLASH HAZARD STUDY

- .1 Calculate the estimated arc current at all new overcurrent protective devices and at all existing 600 volt overcurrent protective devices feeding motors or rated 100 amperes and greater.
- .2 Estimate arcing time from the protective device characteristics and the contributing arc current passing through this device.
- .3 Calculate the incident energy for the device at expected working distances.
- .4 Determine the hazard/risk category (HRC) for the calculated incident energy level.
- .5 Calculate the flash protective boundary for the equipment.
- .6 Analysis shall be performed using:
 - .1 NFPA 70E Standard for Electrical Safety Requirements for Employee Workplace.
 - .2 IEEE-1584 Guide for Performing Arc-Flash Hazard Calculations.
 - .3 ANSI/NEMA Z535.4 Product Safety Signs and Labels.
 - .4 CSA Z462-12 Workplace Electrical Safety.
- .7 Provide one line diagrams indicating maximum calculated arc flash hazards and incident energies.
- .8 Each warning label shall indicate the shock and arc flash hazard/risk categories, the specific level of hazard present, the maximum level of incident energy that could result from an electrical arc, the required Personal Protective Equipment and the relevant working boundaries for that overcurrent protective device.
- .9 Provide sample Energized Electrical Work Permit form and equipment Electrical Shock and Flash Hazard warning labels for the review and approval by the DCC Representative.

1.5 MAINTENANCE MATERIALS

- .1 The Contractor shall provide a recommended spare parts list with the following information provided as a minimum:
 - .1 Contact information for the closest parts stocking location to the Owner.
 - .2 Critical spare parts shall be identified as those parts being associated with long lead times and/or those being critical to the unit's operation.
 - .3 Maintenance spares shall be identified as being those parts required to regularly perform scheduled maintenance on the furnished equipment. These spares shall include, but shall not be limited to, consumable spares that are required to be exchanged during scheduled maintenance periods.

- .2 Spare parts shall be provided for each type and size of unit installed. At a minimum, the following shall be provided:
 - .1 Provide the minimum spare parts recommended by the manufacturer.
 - .2 Provide three spare fuses of each type and rating for power and control installed within equipment. Provide a suitable metal storage cabinet for the fuses, wall mounted in main electrical room.
- .3 Provide any manufacturer specific special tool, not normally found in an electrician's toolbox, required to remove and install recommended or furnished spare parts.

1.6 MANUFACTURER

- .1 Install circuit breakers and/or fusible switches in panelboards or switchgear at factory.
- .2 Circuit breakers and disconnect switches to be product of one manufacturer throughout the project.
- .3 The manufacturer or their representative shall have service, repair and technical support services available 24 hours a day and 7 days a week.
- .4 The manufacturer shall have a valid ISO 9001 certification and an applicable quality assurance system that is regularly reviewed and audited by a third-party registrar. Manufacturing, inspection, and testing procedures shall be developed and controlled under the guidelines of the quality assurance system.
- .5 Acceptable manufacturers of power distribution equipment include:
 - .1 Schneider Electric
 - .2 Eaton - Cutler Hammer
 - .3 Siemens
 - .4 General ElectricAlternate manufacturers may be proposed provided that they meet or exceed the performance requirements of this specification and are compatible with equipment that may be interconnected to the existing distribution equipment.
- .6 Equipment supplied shall have interrupting capacities in excess of calculated short circuit values indicated in the co-ordination study or those indicated on drawings or in these specifications, whichever is the highest.

1.7 SPRINKLERPROOF EQUIPMENT

- .1 Equipment located in sprinklered rooms shall meet the requirements set out by the Inspection Authority for such equipment, which have openings for ventilation, etc., be provided with shields to prevent direct water entry from sprinklers.
- .2 Comply also with the requirements specified in Section 26 05 00.

1.8 SERIES RATED SHORT CIRCUIT PROTECTION

- .1 Interrupting ratings shown on the drawings and as specified herein are based on fully rated devices.
- .2 Series rated devices tested and labeled in accordance with CSA C22.2 will be considered as equivalent.
- .3 Submit published tested series ratings with the shop drawings for the intended devices.

Part 2 Products

2.1 DISCONNECT SWITCHES

- .1 Heavy duty disconnect switches, EEMAC 1 in dry locations, EEMAC 3 in damp locations, quick-made/quick-break mechanisms, visible blades, arc quencher for switches rated 600V.
- .2 Mechanically interlocked cover to prevent opening in “ON” position, except by defeat mechanism.
- .3 ON-OFF switch position indication on switch enclosure cover.
- .4 Provision for padlocking in both “ON” and “OFF” positions.
- .5 Provide fused or unfused disconnect switches as indicated. Devices shall not be retrofitted in the field.
- .6 HRC fuseholders sized as indicated.

2.2 FUSES

- .1 CSA C22.2 No. 59.1 – M1987 (R1997) for fuses.
- .2 CSA C22.2 No. 106 – M92 (R2001) for HRC fuses.
- .3 Fuses: product of one manufacturer.
- .4 HRC-L fuses (formerly Class L).
 - .1 Type L1, time delay, capable of carrying 500% of its rated current for 10 s minimum.
 - .2 Type L2, fast acting.
- .5 HRCI-J fuses (formerly Class J).
 - .1 Type J1, time delay, capable of carrying 500% or its rated current for 10 s minimum.
 - .2 Type J2, fast acting.
 - .3 HRCI-R fuses (formerly Class R). For UL Class RK1 fuses, peak let-through current and 12t values not to exceed limits of UL 198E-1982, table 10.2.
 - .4 Type R1 (UL Class RK1), time delay, capable of carrying 500% of its rated current for 10 s minimum, to meet UL Class RK1 maximum let-through limits.
 - .5 Type R2, time delay, capable of carrying 500% of its rated current for 10 s minimum.
 - .6 Type R3, *UL Class RK1), fast acting Class R, to meet UL Class RK1 maximum let-through limits.
- .6 HRCII-C fuses (formerly Class C).

2.3 MOULDED CASE CIRCUIT BREAKERS AND INSULATED CASE CIRCUIT BREAKERS

- .1 General:
 - .1 Bolt-on moulded case circuit breaker (MCCB): quick-make, quick-break type, for manual and automatic operation with temperature compensation of 40°C ambient.
 - .2 Drawout enclosed, insulated case circuit breaker (ICCB): front accessibility, front connections, drawout cassette with horizontally mounted breaker, viewing window and connected/disconnected position indicator, external racking port, safety mechanism that will not allow the breaker to be connected or removed while the breaker is in the energized position, remote trip indication and control, communication capability and key interlock kit.

- .3 Common –trip breakers: with single handle for multi-pole applications.
- .4 Magnetic instantaneous trip elements in circuit breakers to operate only when value of current reaches setting. Trip settings on breakers with adjustable trips to range from 3-8 times current rating.
- .5 Circuit breakers with interchangeable trips when so indicated on drawings.
- .6 Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HACR for heating, air conditioning, and refrigerating equipment.
- .7 Ground Fault Protection, where indicated: Integral to circuit breaker with adjustable pickup and time delay settings, push to test feature, and ground fault indicator.
- .8 Undervoltage Trip, where indicated: Set to operate at 35 to 75 percent of rated voltage with field adjustable 0.1 second to 0.6 second time delay.
- .9 Communication capability: for PowerPact and MasterPact (Drawout) breakers.
- .10 Key Interlock Kit: Externally mounted to prohibit circuit breaker operation; key shall be removable only when circuit breaker is in off position.
- .2 Thermal magnetic breakers – Design 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.
- .3 Solid state trip breakers – Design D:
 - .1 Micrologic electronic trip unit shall be true RMS sensing.
 - .2 Air core current transformers shall be used to ensure accurate measurements from low currents up to high currents.
 - .3 Electronic trip unit shall be fitted with thermal imaging to protect intermittent short circuits or ground-faults.
 - .4 The following monitoring functions shall be integral parts of electronic trip units:
 - .1 A test connector shall be installed for checks on electronic and tripping mechanism operation using an external device.
 - .2 LED for load indication at 105 percent.
 - .3 LED for load indication at 90 percent of load for applications 600 amperes and smaller
 - .4 LED for visual verification of protection circuit functionality for applications 600 amperes or smaller.
 - .5 Optional: LED for trip indication for applications above 600 amperes.
 - .6 Micrologic trip unit functions shall consist of adjustable protection settings with the capability to be set and read locally by rotating a switch.
 - .7 Long-time pickup shall allow for adjustment to nine long-time pickup settings. This adjustment must be at least from 0.4 to 1 times the sensor plug (In), with finer adjustments available for more precise settings to match the application.
 - .8 Adjustable long-time delay shall be in nine bands. At six times I_r , from 0.5 to 24 seconds above 600 amperes, and 0.5 to 16 seconds for 600 amperes and below.
 - .9 Short-time pickup shall allow for nine settings from 1.5 to 10 times I_r .
 - .10 Short-time delay shall be in nine bands from 0.1–0.4 I^2t ON and 0–0.4 I^2t OFF.
 - .11 Instantaneous settings on the trip units with LSI protection shall be available in nine bands.
 - .1 Above 600 amperes, from 2 to 15 times I_n

- .2 600 amperes, from 1.5 to 11 times In
- .3 400 amperes from 1.5 to 12 times In
- .4 250 amperes and below, from 1.5 to 15 times In
- .12 Four-pole devices shall be equipped for neutral protection with a three-position setting; neutral not protected, neutral tripping threshold equal to half the phase value, and neutral threshold equal to the phase value.
- .13 Ground fault settings for circuit breaker sensor sizes 1200 amperes or below shall be in nine bands from 0.2 to 1.0 times In. The ground fault settings for circuit breakers above 1200 amperes shall be nine bands from 500 to 1200 amperes.
- .5 It shall be possible to fit the trip unit with a seal to prevent unauthorized access to the settings in accordance with NEC Section 240-6(b).
- .6 Trip unit shall provide local trip indication and capability to locally and remotely indicate reason for trip, i.e., overload, short circuit, or ground fault.
- .7 Neutral current transformers shall be available for four-wire systems.
- .8 Trip units shall have the capability to electronically adjust the settings locally and remotely to fine increments below the switch settings. Fine increments for pickup adjustments shall be 1 ampere. Fine increments for delay adjustments shall be one second
- .9 Trip units shall be available to provide real time metering. Metering functions shall include, but shall not be limited to, the following:
 - .1 Current (phases, neutral, average, maximum)
 - .2 Voltage (phase-to-phase, phase-to-neutral, average, unbalance)
 - .3 Power (active [kW], reactive [kVAR], apparent [kVA], power factor)
 - .4 Energy (active [kWh], reactive [kVAR], apparent [kVA])
 - .5 Frequency
 - .6 Total harmonic distortion (current, voltage)
 - .7 Metering accuracy shall be 1.5 percent current (above 600 amperes), 1.0 percent current (600 amperes and below), 0.5 percent voltage, and 2 percent energy. This accuracy shall be total system, including, but not limited to, CT and meter.
- .10 Measurement chain shall be independent from the protection chain.
- .11 The measurements shall be displayed on the breaker itself and/or on a remote display and/or on a remote system via Modbus communication.
- .12 Connections from circuit breaker to remote display and/or communication module shall be plug-n-play via RJ45 connector. No special tools or programming shall be required.
- .13 Optional features available for applications 600 amperes and smaller include:
 - .1 Zone Selective Interlocking
 - .2 Contact wear indication
 - .3 Operation, trip and alarm counters
 - .4 Operating hours' counter
 - .5 Load profile
- .14 Optional features available for applications above 600 amperes include:
 - .1 Inverse definite minimum time lag (IDMTL)
 - .2 Zone selective interlocking
 - .3 Protective relaying functions (Current unbalance, maximum demand current, reverse power, etc...)
 - .4 Phase loading

- .5 Contact wear indication
- .6 Wave form capture
- .7 Data logging

2.4 DISTRIBUTION AND BRANCH CIRCUIT PANELBOARDS

- .1 Panelboards: product of one manufacturer.
 - .1 Install circuit breakers in Panelboards before shipment.
 - .2 In addition to CSA requirements manufacturer's nameplate must show fault current that the panel and breakers have been built to withstand.
- .2 250 and 600 V panelboards: bus and breakers rated for symmetrical interrupting capacity in accordance with the Protection Co-ordination Study or as indicated on drawings with minimum values as follows, whichever is highest.
 - .1 In Distribution and Branch Circuit Panels, the minimum interrupting rating for the breakers, unless indicated otherwise, shall be:
 - .1 10,000 A rms symmetrical for 208 V Panels
 - .2 25,000 A rms symmetrical for 600 V Panels
 - .2 Breakers in Distribution Panels shall be design A or C as required. However, where it is necessary for proper coordination, provide Design D breakers.
- .3 Sequence phase bussing with odd numbered breakers on left and even on right, with each breaker identified by permanent number identification as to circuit number and phase.
- .4 Panelboards: mains, number of circuits, and number and size of branch circuit breakers as indicated.
- .5 Two keys for each panelboard and key panelboards alike.
- .6 All panelboards complete with ground bus.
- .7 Copper busses with 100% ampere rated neutral bus. Provide at 200% ampere rated neutral bus, where indicated.
- .8 Mains: suitable for bolt-on breakers.
- .9 Trim with concealed front bolts and hinges.
- .10 Trim and door finish: baked grey enamel.
- .11 Doors and trim shall be minimum 12 gauge.
- .12 All single tub branch circuit panelboards shall be complete with double mains lugs to allow the addition of a second tub.
- .13 All branch circuit panelboards shall be complete with main breaker when these panelboards are not in the same room as the Distribution Panel feeding them, and where indicated.

2.5 OVERCURRENT PROTECTION FOR MECHANICAL EQUIPMENT

- .1 The ratings of some overcurrent devices, indicated on the drawings, are to be confirmed after review of mechanical shop drawings. This may require that these be shipped separately after delivery of panelboards.

Part 3 Execution

3.1 INSTALLATION

- .1 Fasten floor-mounted equipment such as dry type transformers securely to the floor. Refer to Section 26 05 00 for seismic requirements.
- .2 Check factory made connections for mechanical security and electrical continuity. Verify fuse sizes and trip unit settings with the co-ordination study.
- .3 Examine equipment exterior and interior prior to installation. Report any damage and do not install any equipment that is structurally, moisture, or mildew damaged.
- .4 Verification of Conditions: Examine areas and conditions under which the work is to be installed, and notify the Contractor in writing, with a copy to the Owner, DCC representative and Engineering Consultant, of any conditions detrimental to the proper and timely completion of the work. Do not proceed with the work until unsatisfactory conditions have been corrected.
 - .1 Check that concrete pads are level and free of irregularities.
 - .2 Installation space is enclosed and weatherproof.
 - .3 Any wet-work located in or in close proximity to switchboard installation location is completed and nominally dry.
 - .4 Work above ceilings is complete.
- .5 Install equipment in accordance with reviewed product data, final shop drawings, manufacturer's written instructions and recommendations, and as indicated on the Drawings.
- .6 Verify layout of electrical rooms prior to installation, using actual equipment dimensions, to ensure adequate clearances and ventilation.
- .7 Adjust isolation pad bolts, tighten conduit connections and fastenings etc., to minimize transformer noise.
- .8 Install and wire disconnect switches.
- .9 Adjust circuit breaker trip and time delay settings to values indicated within coordination study.
- .10 Physically test key interlock systems to check for proper functionality prior to energizing.

3.2 TESTING AND COMMISSIONING

- .1 Carry out Testing and Commissioning in accordance with Section 26 57 01, 26 57 02 and 26 57 03.

END OF SECTION

Part 1 General

1.1 REFERENCES

- .1 CSA International
 - .1 CSA C22.2 No.42-10 (R2015), General Use Receptacles, Attachment Plugs and Similar Wiring Devices.
 - .2 CAN/CSA C22.2 No.42.1-13, Cover Plates for Flush-Mounted Wiring Devices (Bi-national standard, with UL 514D).
 - .3 CSA C22.2 No.111-10 (R2015), General-Use Snap Switches (Bi-national standard, with UL 20).
 - .4 Equipment and components for ground fault circuit interrupters (GFCI): to CAN/CSA-C22.2 No.144-M91 (R2011).

1.2 ACTION AND INFORMATION SUBMITTALS

- .1 Submit in accordance with Section 26 05 00 – Common Work Results for Electrical.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for wiring devices and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Shop Drawings:
 - .1 Submit drawings stamped and signed by professional engineer registered or licensed in Province of Ontario, Canada.
 - .1 Indicate on drawings:
 - .1 Changes/modifications to:
 - .1 Circuitry; and
 - .2 Equipment locations

1.3 CLOSEOUT SUBMITTALS

- .1 Submit in accordance with Section 26 05 00 – Common Work Results for Electrical.
- .2 Operation and Maintenance Data: submit operation and maintenance data for wiring devices for incorporation into manual.

1.4 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 26 05 00 – Common Work Results for Electrical and as per manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store materials off ground, indoors, in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect wiring devices from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.

- .4 Develop Construction Waste Management Plan related to Work of this Section.
- .5 Packaging Waste Management: remove for reuse and return of pallets, crates, padding, and packaging materials as specified in Construction Waste Management Plan.

Part 2 Products

2.1 SWITCHES

- .1 15A, 120 V, single pole switches to: CSA C22.2 No.111.
- .2 Manually-operated general purpose AC switches with following features:
 - .1 Terminal holes approved for No. 10 AWG wire.
 - .2 Silver alloy contacts.
 - .3 Urea or melamine moulding for parts subject to carbon tracking.
 - .4 Suitable for back and side wiring.
 - .5 White toggle.
- .3 Toggle operated fully rated for LED lamps, and up to 80% of rated capacity of motor and heating/cooling loads.
- .4 Switches of one manufacturer throughout project.

2.2 RECEPTACLES

- .1 Duplex receptacles, CSA type 5-15 R, 125 V, 15 A, U ground, to: CSA C22.2 No.42 with following features:
 - .1 White urea moulded housing.
 - .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.
 - .6 Heavy duty one-piece grounding system.
 - .7 Heavy duty, corrosion resistant double plated yoke.
 - .8 Premium Specification Grade.
- .2 Other receptacles with ampacity and voltage as indicated.
- .3 Receptacles of one manufacturer throughout project.

2.3 COVER PLATES

- .1 Cover plates for wiring devices to: CSA C22.2 No.42.1.
- .2 Brushed finish stainless steel type 301, minimum 1.0 mm thick, chrome plated screws. Protective film for removal after finishing.
- .3 Sheet steel utility box cover for wiring devices installed in surface-mounted utility boxes.
- .4 Cast metal cover plates for wiring devices mounted in surface-mounted FS or FD type conduit boxes.
- .5 In Janitor's Rooms, mechanical and electrical service rooms: galvanized pressed steel.

- .6 In damp and exterior locations: weatherproof, spring loaded, cast aluminum coverplates with gaskets.
- .7 Cover plates from one manufacturer throughout project.

2.4 PHOTOCCELL

- .1 Sealed cadmium sulphide photocell, temperature range -34°C to 60°C, SPST, 1200W, 120V with nylon lock nut c/w stainless steel coverplate for flush mounting in standard single gang box.

2.5 SURGE PROTECTIVE DEVICE (SPD)

- .1 All units to be manufactured to UL 1449 ratings tested to Nema L-S1 for performance during and after a surge injection confirm to IEEE C62.41-1991.
- .2 Test results to be provided upon request.
- .3 Suppressors to be MCOV style with protection in all modes (L-N, L-G, L-L, N-G).
- .4 Refer to Descriptions on Single Line Diagram on Drawings for ratings and locations of SPD's.

2.6 HANDICAP DOOR OPERATORS

- .1 Reference the Hardware Schedule.
- .2 Hardware supplied by others, all line and low voltage wiring and required transformation to be provided by Division 26.

2.7 GROUND FAULT RECEPTACLES

- .1 Self-contained with 15 A, 120 V circuit interrupter and duplex receptacle complete with:
 - .1 Solid state ground sensing device.
 - .2 Facility for testing and reset.
 - .3 CSA Enclosure, flush mounted.

Part 3 Execution

3.1 INSTALLATION

- .1 Switches:
 - .1 Install single throw switches with handle in "UP" position when switch closed.
 - .2 Install switches in gang type outlet box when more than one switch is required in one location.
 - .3 Mount toggle switches at height in accordance with Section 26 05 00 - Common Work Results for Electrical unless otherwise specified.
 - .4 Identify all switches as specified in Section 26 05 00
- .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 for Electrical, unless otherwise specified.
 - .3 Where split receptacle has one portion switched, mount vertically and switch upper portion.

- .4 Install GFI type receptacles as indicated.
- .5 Provide vapour barrier box on all exterior wall outlets.
- .6 Identify all receptacles as specified in Section 26 05 00. Also ensure that receptacle colours are as specified in section 2.2.
- .3 Cover plates:
 - .1 Install suitable common cover plates where wiring devices are grouped.
 - .2 Do not use cover plates meant for flush outlet boxes on surface-mounted boxes.
 - .3 Provide blank cover plates for all unused outlet boxes.
 - .4 Protect stainless steel coverplate finish with paper or plastic film until painting and other work is finished. Remove protective film from covers after painting.
- .4 Devices in millwork:
 - .1 Co-ordinate wiring devices in furniture with furniture supplier. Cut-outs for boxes to be provided by the furniture manufacturer.

3.2 CLEANING

- .1 Progress Cleaning: Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment.

3.3 PROTECTION

- .1 Protect installed products and components from damage during construction.
- .2 Protect stainless steel cover plate finish with paper or plastic film until painting and other work is finished.
- .3 Repair damage to adjacent materials caused by wiring device installation.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 23 11 13 – Facility Fuel Oil Piping

1.2 REFERENCE STANDARDS

- .1 National Association of Corrosion Engineers (NACE)
 - .1 NACE SP0169-13, Control of External Corrosion on Underground or Submerged Metallic Piping Systems
- .2 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
 - .1 Safety Data Sheets (SDS)

1.3 SYSTEM DESCRIPTION

- .1 Design Responsibility: NACE certified specialist to select and design cathodic protection system to protect:
 - .1 Entire telethermics systems, sectionalized as indicated.
 - .2 Steel manholes.
 - .3 Other buried steel structures.

1.4 DESIGN REQUIREMENTS

- .1 General: Sufficient anodes for 20 years of operation without replacement, based upon earth resistivity tests performed on site by manufacturer.
- .2 Sacrificial anode system:
 - .1 Base design on 3% of total conduit surface assumed to be bare and application of 0.0014 mA/m² of total buried conduit surface, conduit-to-soil potential of 0.850 V or more, negative.
 - .2 Anodes: Magnesium

1.5 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's printed product literature, specifications and datasheet and include product characteristics, performance criteria, physical size, finish and limitations.
 - .2 Submit two copies WHMIS SDS - Safety Data Sheets.
- .3 Shop Drawings: Submit drawings stamped and signed by professional engineer registered or licensed in Ontario, Canada, and include:

- .1 Soil analysis, details affecting design, calculations, locations of anodes, test stations, routes of connecting cables, installation procedures, wire splicing details, hardware, accessories.
- .4 Quality Assurance Submittals: Submit the following in accordance with Section 01 45 00 - Quality Control.
 - .1 Test Reports: Submit certified test reports from approved independent testing laboratories, indicating compliance with specifications for specified performance characteristics and physical properties.
 - .2 Certificates: Submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
 - .3 Manufacturer's Instructions: Submit manufacturer's installation instructions and special handling criteria, installation sequence and cleaning procedures.
- .5 Manufacturer's Site Reports: Submit manufacturer's written reports within 3 days of review, verifying compliance of Work, as described in PART 3 - SITE QUALITY CONTROL.
- .6 Closeout Submittals:
 - .1 Provide maintenance data and incorporate into manual specified in Section 01 78 00 - Closeout Submittals.
 - .2 Data to include:
 - .1 A manual repeating and expanding upon oral operating and maintenance instructions.
 - .2 Record drawings showing locations of anodes, test stations, routes and cable routes.

1.6 QUALITY ASSURANCE

- .1 Preinstallation Meetings: Convene preinstallation meeting one week before beginning work of this Section and on-site installation, with Contractor, DCC Representative and Consultant in accordance with Section 01 31 19 - Project Meetings to:
 - .1 Verify project requirements.
 - .2 Review installation and substrate conditions.
 - .3 Coordination with other building subtrades.
 - .4 Review manufacturer's installation instructions and warranty requirements.
- .2 Site Meetings: As part of Manufacturer's Services described in PART 3 - SITE QUALITY CONTROL, schedule site visits, to review Work, at stages listed.
 - .1 After delivery and storage of products, and when preparatory Work is complete, but before installation begins.
 - .2 Twice during progress of Work at 25% and 60% complete.
 - .3 Upon completion of Work, after cleaning is carried out.

1.7 DELIVERY, STORAGE, AND HANDLING

- .1 Packing, shipping, handling, and unloading:

- .1 Deliver, store, and handle materials in accordance with Section 01 61 00 - Common Product Requirements.
- .2 Waste Management and Disposal:
 - .1 Separate waste materials for reuse and recycling in accordance with Section 01 74 19 - Waste Management and Disposal.

1.8 COMMISSIONING

- .1 Do commissioning in accordance with Section 01 91 13 - General Commissioning Requirements.
- .2 Manufacturer to commission system and to certify in final written report to DCC Representative and Consultant satisfactory installation and performance.
- .3 Provide testing and maintenance program.
- .4 Provide additional anodes as required to ensure adequate performance of cathodic protection system for 20 years.
- .5 Report to include latest estimated life expectancy of anodes.
- .6 Retest 6 months after completion of backfilling.
 - .1 Submit written report to DCC Representative and Consultant.

Part 2 Products

2.1 ANODES

- .1 7.6 kg magnesium, with the following composition: Aluminum: 5.3-6.7% Manganese: 0.15% min. Zinc: 2.5-3.5% Silicon: 0.13% max. Copper: 0.05% max. Nickel: 0.003% max. Iron: 0.003% max.
 - .1 Other: 0.3% max. Magnesium: remainder.
- .2 Cast with perforated steel strap core mechanically secured and silver soldered to anode lead wire.
- .3 Anode: Completely surrounded by 12.7 mm minimum of packing firmly compacted by vibration in permeable cloth. Packing to pass 100 mesh screen and consist of:
 - .1 Ground hydrated lime: 75%
 - .2 Powdered Wyoming bentonite: 20%
 - .3 Anhydrous sodium sulfate: 5%

2.2 CONDUCTOR AND LEAD WIRES

- .1 #12 type THWN solid copper wire or as indicated.

2.3 WIRES FOR TEST PURPOSES

- .1 #12 type THWN solid copper wire or as indicated.

2.4 ELECTRICAL ISOLATION MATERIALS

- .1 Include fittings, flanges, bolts, nuts, washers, gasket materials suitable for service, operating temperatures, pressures.

2.5 COATINGS

- .1 Electrically resistant, highly resistant to mechanical damage.

2.6 LINK SEALS

- .1 Modular mechanical type consisting of interlocking synthetic rubber links, high strength non-creep glass-reinforced pressure plates, corrosion resistant bolts and nuts.
- .2 Sizes, number of links, as recommended by manufacturer.

2.7 BURIED CABLE SPLICES

- .1 Copper compression bolts, electrical putty, 19 mm wide rubber insulating tape, 19 mm wide plastic insulating tape.

2.8 CABLE CONNECTIONS

- .1 Welded connections:
 - .1 Materials for welding copper cables to protected work suitable for thermit reaction welding process.
- .2 Pressure type:
 - .1 Clamp type.

Part 3 Execution

3.1 SITE INVESTIGATIONS

- .1 NACE certified specialist to survey entire route of piping system at proposed installation depth.
- .2 Analyze soil samples for chemical constituents, electrical resistivity, water soluble salt content, calcium, sulphate, chloride, content and pH of soil.
- .3 Survey to include other details affecting design:
 - .1 Details of protected works.
 - .2 Protective coatings.
 - .3 Surrounding environment.
 - .4 Presence of neighbouring metal structures.
 - .5 Stray currents in vicinity.
 - .6 Number, locations of foreign utilities.
 - .7 Proximity of other cathodic protection systems which may affect or be affected by operation of this system.

- .4 Submit report to DCC Representative and Consultant indicating soil analysis, type of cathodic protection system recommended.

3.2 ON-SITE SUPERVISION

- .1 Cathodic protection system manufacturer's NACE certified corrosion specialist to provide instructions for, and supervision of, installation, and commissioning of system.

3.3 BURIED CABLE SPLICES

- .1 Use the following procedures:
 - .1 Strip away 50 mm insulation: attach bolt.
 - .2 Cover connection with layer of putty.
 - .3 Wrap with 3 layers half lap rubber insulating tape.
 - .4 Finish with 3 layers half lap vinyl plastic tape.

3.4 CONNECTION OF WIRES

- .1 Use thermal reaction welding process.
- .2 Clean to bare metal.
- .3 After welding, remove slag, cover with bitumastic coating or other material compatible with original coating.

3.5 COATINGS

- .1 Before and after installation:
 - .1 Inspect for complete coverage.
 - .2 Patch damaged coating using same material as original coatings.
- .2 DCC Representative and Consultant to certify satisfactory installation.

3.6 TEST STATIONS

- .1 Locate at 100 m intervals or as indicated.
- .2 Arrange to permit periodic evaluation and overall effectiveness of cathodic protection system, as follows:
 - .1 At Buildings: House test leads in electrical conduit terminated in waterproof cast iron housing affixed to structure.
 - .2 At every manhole where distance between manholes exceeds 300 m: terminate leads at test station with 450 mm of slack material at ground surface in waterproof cast iron housing encased in concrete.
- .3 Test leads terminating in test stations to have at least 500 mm slack lead below grade.

3.7 ELECTRICAL ISOLATION

- .1 Isolate protected work into sections using electrically isolated flanges, bolts, nuts and washers.
- .2 Isolate protected work from other buried metallic systems and/or structures, steel reinforced concrete, buildings, piping systems inside buildings.
- .3 Provide everything necessary for stray current control.
- .4 Select size of wall opening and link seal to ensure complete electrical isolation and watertight joints.

3.8 WIRING

- .1 Install to manufacturer's instructions.
- .2 Weld anode wire directly to protected work using welding procedures approved by manufacturer and run to test stations.
- .3 Splice anode wire to common gathering wire laid parallel to protected work and run to test station.
- .4 Weld cathode wire to protected work and run to test station.

3.9 WELDING

- .1 Welds at Protected Work: Moisture-proofed, covered with coatings compatible with original protective coatings.

3.10 CONTINUITY

- .1 Provide joint bonds or other means to ensure that cathodic protection system is installed as designed.
- .2 Before backfilling, test for electrical continuity of piping systems.

3.11 BACKFILLING

- .1 Supervise backfilling of protected work and cathodic protection systems to ensure that neither is damaged or that cathodic protection systems are not compromised.
- .2 Anodes: Backfill in neutral earth firmly packed around anodes to eliminate air pockets.
 - .1 Drench anodes thoroughly in water so that anode packing is saturated.
 - .2 Immediately, install backfill to 300 mm above anode to prevent drying out.
- .3 Backfilling: To Section 31 23 33.01 - Excavating, Trenching and Backfilling.

3.12 SITE QUALITY CONTROL

- .1 Site Tests and Inspections:

- .1 Test systems to NACE SP0169 recommendations.
 - .1 Include pipe-to-soil potential and anode current output under all soil conditions.
 - .2 Test for full supervision of circuitry.
- .2 After backfilling, manufacturer's NACE certified corrosion specialist to conduct final inspection
- .3 On completion, submit final report to DCC Representative and Consultant.
- .4 Indicate in final report latest estimated life expectancy of anodes.
- .5 Manufacturer's Site Services:
 - .1 Obtain written report from manufacturer verifying compliance of Work, in handling, installing, applying, protecting and cleaning of product and submit Manufacturer's Site Reports as described in PART 1 - SUBMITTALS.
 - .2 Provide manufacturer's site 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.

3.13 CLEANING

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

3.14 DEMONSTRATION AND TRAINING

- .1 Arrange for installer or manufacturer to demonstrate system and to train owner's personnel on aspects of system design, and in operation and maintenance of equipment in accordance with Section 01 79 00 - Demonstration and Training.

END OF SECTION

Part 1 General

1.1 REFERENCES

- .1 Ontario Electrical Safety Code, Current Edition.
- .2 IEEE C62.41, Guide on the Surge Environment in Low-Voltage (1000 V and Less) AC Power Circuits
- .3 FCC 47 CFR Part 15, Federal Code of Regulation (CFR) testing standard for electronic equipment
- .4 IESNA LM-79-08, Electrical and Photometric Measurements of Solid-State Lighting Products
- .5 IESNA LM-80-08, Approved Method for Measuring Lumen Maintenance of LED Light Sources
- .6 IESNA TM-15, Luminaire Classification System for Outdoor Luminaires
- .7 IESNA TM-21-11, Technical Memorandum on Projecting Long Term Lumen Maintenance of LED Light Sources.
- .8 NEMA SSL 1-2016, Electronic Drivers for LED Devices, Arrays, or Systems.
- .9 NEMA SSL 3-2011, High-Power White LED Binning for General Illumination
- .10 ASTM B117, Salt Spray Test Standard
- .11 ANSI C136.10, Locking photocell devices
- .12 ANSI C136.31, Roadway Luminaire Vibration Testing
- .13 NEMA IEC60529, Degrees of Ingress Protection by Enclosures

1.2 DRAWINGS

- .1 The drawings, which constitute a part of these specifications, indicate the general location of the luminaires. Data presented on these drawings is as accurate as preliminary surveys and planning can determine until final equipment selection is made. Accuracy is not guaranteed and field verification of all dimensions, routing, etc., is required.
- .2 Specifications and drawings are for assistance and guidance, but exact locations, distances and levels will be governed by actual field conditions. Contractor is directed to make field surveys as part of his work prior to submitting system layout drawings.

1.3 QUALITY ASSURANCE

- .1 Luminaires shall be of uniform quality and appearance.
- .2 Manufacturers of LED luminaires shall demonstrate a suitable testing program incorporating high heat, high humidity and thermal shock test regimens to ensure system reliability and to substantiate lifetime claims.
- .3 The LED fixture assembly/manufacturing facility shall be ISO 9001 certified and in compliance to RoHS (Restriction of Hazardous Substances Directive)
- .4 At time of manufacture, electrical and light technical properties shall be recorded for each luminaire. At a minimum, this should include lumen output, CCT, and CRI. Each luminaire shall utilize a unique serial numbering scheme. Technical properties must be made available for a minimum of 7 years after the date of manufacture.

- .5 Luminaires shall be provided with a 5-year warranty covering, LEDs, drivers, paint and mechanical components.

1.4 SUBMITTALS

- .1 Submit product data on luminaires. Product data to include, but not limited to:

- .1 Luminaire:

- .1 Manufacturer and catalog number,
 - .2 Type (identification) as indicated on the plans and schedule,
 - .3 Delivered lumens,
 - .4 Input watts,
 - .5 Efficacy,
 - .6 Color rendering index.
 - .7 Materials and finishes
 - .8 Photometric performance
 - .9 Dimensional information
 - .10 Approvals

- .2 Driver:

- .1 Manufacturer and catalog number,
 - .2 Type (Non-Dimming, Step-dimming, Continuous dimming, etc.),
 - .3 Power Factor, Crest Factor, THD, etc.

- .3 Pole (if applicable):

- .1 Diameter
 - .2 Height
 - .3 Pole thickness
 - .4 Weight
 - .5 Construction Material
 - .6 Colour and Type of finish

1.5 DELIVERY, STORAGE AND HANDLING

- .1 Deliver luminaires and components carefully to avoid breakage, bending and scoring finishes. Do not install damaged equipment.
- .2 Store luminaires and accessories in original cartons and in clean dry space; protect from weather and construction traffic.

1.6 EXTRA MATERIALS

- .1 Provide one (1) of each type of LED module, light bar, or array (if applicable). If the LED's are integrated into the luminaire and are not separate components, provide one (1) of each of these types of luminaires.
- .2 Provide one (1) LED driver or ballast of each type.

1.7 DEFINITIONS

Driver: The power supply used to power LED luminaires, modules, or arrays.

L70, L₇₀, or L_{70%}: The reported life of an LED component or system to reach 70% lumen maintenance, or 70% of the LED's original light output. This test is being developed by the IES and is currently described by TM-21-11.

LED's: Broadly defined as complete luminaire with light emitting diode (LED) packages, modules, light bars or arrays, complete with driver.

LED luminaire failure: Negligible light output from more than 10 percent of the LED's constitutes luminaire failure.

Part 2 Products

2.1 ACCEPTABLE MANUFACTURERS

- .1 Manufacturer: Subject to compliance with these specifications, luminaires shall be as manufactured by Eaton (Cooper) Lighting, Signify (Philips) Lighting, Acuity, Hubbell and GE Lighting.
- .2 The technical requirements that the luminaire shall meet for each type are:
 - .1 Minimum Light Output.
 - .2 Zonal Lumen Requirements.
 - .3 Minimum Luminaire Efficacy.
 - .4 Minimum CRI.
 - .5 L70 Lumen Maintenance.
 - .6 Minimum Luminaire Warranty of 5 years (not pro-rated) to include LED driver and all LED components.

2.2 LED LUMINAIRES

- .1 General: Except as otherwise indicated, provide LED luminaires, of types and sizes indicated in Luminaire Schedule on Drawings.
- .2 Fixtures complete with drivers or ballasts and necessary accessories to be factory assembled for installation, wiring and lamping. Provide remote drivers as required and as indicated on drawings.
- .3 Acrylic lenses for interior luminaires to be minimum 3.175mm thick.
- .4 Recessed fixtures to be complete with trim type required for ceiling system installed. Before ordering, confirm the ceiling construction details and architectural finish for each area. Recessed fixtures in inaccessible ceilings to have sufficient access to wiring connections to be acceptable to the Inspection Authority. Pre-wired types with junction boxes forming an integral part of the assembly shall have satisfactory access complete with all necessary plastic rings, supports, etc. as required
- .5 Material and specifications for each luminaire are as follows:
 - .1 Each Luminaire shall consist of an assembly that utilizes LEDs as the light source. In addition, a complete Luminaire shall consist of a housing, LED array, and electronic driver (power supply).
 - .2 Each Luminaire shall be rated for a minimum operational life of 70,000 hours of operations at an average operating time of 12 hours per day.
 - .3 The rated operating temperature range shall be -30°C to +40°C for luminaires.
 - .4 Photometry must be compliant with IESNA LM-79-08 and shall be conducted at 25°C ambient temperature.

- .5 Each Luminaire shall meet all parameters of this specification throughout the minimum operational life when operated at the average nighttime temperature.
 - .6 The individual LEDs shall be constructed such that a catastrophic loss or the failure of one LED will not result in the loss of the entire Luminaire.
 - .7 Luminaire shall be constructed such that LED modules may be replaced or repaired without replacement of whole Luminaire.
 - .8 Each Luminaire shall be Certified to CSA Standards for luminaires.
 - .9 Luminaire shall maintain 70% lumen output (L70) for a minimum of 50,000 hours.
 - .10 Lumen output shall not depreciate more than 20% after 10,000 hours of use.
- .6 Technical Requirements
- .1 Electrical
 - .1 Power Consumption: Maximum power consumption allowed for the Luminaire shall be determined by application. The Luminaire shall not consume power in the off state.
 - .2 Operation Voltage: The Luminaire shall operate from a 60 HZ ± 3 HZ AC line over a voltage ranging from 108 VAC to 360 VAC. The fluctuations of line voltage shall have no visible effect on the luminous output.
 - .3 Power Factor: The Luminaire shall have a minimum power factor of 0.90 and a maximum crest factor (CF) of 1.5 at full input power and across specified voltage range.
 - .4 THD: Total harmonic distortion (current and voltage) induced into an AC power line by a Luminaire shall not exceed 20 percent.
 - .5 Surge Suppression: The Luminaire on-board circuitry shall include surge protection devices (SPD) to withstand high repetition noise transients as a result of utility line switching, nearby lightning strikes, and other interference. The SPD shall protect the Luminaire from damage and failure for common mode transient peak voltages up to 10 kV (minimum) and transient peak currents up to 5 kA (minimum). SPD shall conform to UL 1449, or UL 1283, depending of the components used in the design. SPD performance shall be tested per the procedures in ANSI/IEEE C62.41-1992 (or current edition) for category C (standard). The SPD shall fail in such a way as the Luminaire will no longer operate. The SPD shall be field replaceable.
 - .6 Operational Performance: The LED circuitry shall prevent visible flicker to the unaided eye over the voltage range specified above.
 - .7 RF Interference: LED Drivers must meet Class A emission limits referred in Federal Communications Commission (FCC) Title 47, Subpart B, Section 15 regulations concerning the emission of electronic noise.
 - .8 Drivers shall have a Class A sound rating.
 - .9 Wiring connections to LED drivers shall utilize polarized quick-disconnects for field maintenance.
 - .2 Dimming Drivers:
 - .1 LED driver shall be compatible with dimming controls where dimming is indicated on the plans. Dimmable drivers shall use Dimming Constant Current (DCC) or Pulse Width Modulation (PWM) operation.
 - .2 Step-Dimming Drivers: Easily switched from 0% to 50% to 100% output power. Both switch-leg inputs shall control 50% of the luminaire's light output equally.

- .3 Continuous Dimming Drivers: LED luminaires shall dim to (20%, 15%, 10%, 5%, or 0.1%) as specified in the Luminaire Schedule on the plans without visible flicker or “popcorn effect”. “Popcorn effect” is defined as the luminaire being on a pre-set dimmed level (less than 100%) and going to 100% prior to returning to the pre-set level when power is returned to the luminaire. Continuous Dimming Drivers shall use 0-10V control.

.7 Photometric Requirements

- .1 Optical Assemblies for Exterior Mounted Luminaires: LEDs shall be provided with discreet optical elements to provide IESNA Type II, III, IV or V distributions. Additional distributions for spill light control shall be utilized when light trespass must be mitigated. Optical assemblies shall have a minimum efficiency of 85% regardless of distribution type. For Type II and Type III distributions street side efficiencies shall be a minimum of 80%. All LEDs and optical assemblies shall be mounts parallel to the ground. All LEDs shall provide the same optical pattern such that catastrophic failures of individual LEDs will not constitute a loss in the distribution pattern.
- .2 All photometric data will be measured by the IESNA LM-79-08 standard and formatted per IESNA LM-63-02 as an electronic “.IES” file.
- .3 Illuminance: The illuminance shall not decrease by more than 30% over the expected operating life. The measurements shall be calibrated to standard photopic calibrations.
- .4 Light Color/Quality: The luminaire shall have a correlated color temperature (CCT) of 4,000K. The color rendition index (CRI) shall be 80 or greater. Binning of LEDs shall conform to ANSI/ G. NEMA SSL 3-2010.
- .5 Backlight-Uplight-Glare: The Luminaire shall not allow more than 10 percent of the rated lumens to project above 80 degrees from vertical. The Luminaire shall not allow more than 2.5 percent of the rated lumens to project above 90 degrees from vertical. Backlight and Glare ratings as per fixture schedule and calculated per IESNA TM-15.

.8 Thermal Management

- .1 The thermal management (of the heat generated by the LEDs) shall be of sufficient capacity to assure proper operation of the Luminaire over the expected useful life.
- .2 The LED manufacturer’s maximum thermal pad temperature for the expected life shall not be exceeded.
- .3 Thermal management shall be passive by design. The use of fans or other mechanical devices shall not be allowed.
- .4 The Luminaire shall have a minimum heat sink surface such that the LED manufacturer’s maximum junction temperature is not exceeded at maximum rated ambient temperature.
- .5 The heat sink material shall be aluminum.

.9 Physical and Mechanical Requirements

- .1 The Luminaire shall be a single, self-contained device, not requiring on-site assembly for installation. The power supply for the Luminaire shall be integral to the unit.
- .2 The maximum weight of the Luminaire shall be 35 lbs.
- .3 The maximum effective projected area (when viewed from either side or either end) for exterior mounted luminaires shall be 1.4 sq. ft.
- .4 Each housing for pole mounted luminaires shall be provided with a slip-fitter capable of mounting on a 2 inch pipe tenon. This slip-fitter shall fit on mast-arms from 1-5/8 to 2-3/8 in (O.D.) The slip-fitter shall be capable of being adjusted a minimum of ±5 degrees from the axis of the tenon in a minimum of five steps (+5, +2.5, 0, -2.5, -5). The

clamping brackets of the slip-fitter shall not bottom out on the housing bosses when adjusted within the designed angular range. No part of the slip-fitter mounting brackets on the luminaires shall develop a permanent set in excess of 1/32 in. when the two or four 3/8 in. diameter cap screws used for mounting are tightened to 10 ft-lb.

- .5 The assembly and manufacturing process for the LED Luminaire shall be designed to assure all internal components are adequately supported to withstand mechanical shock and vibration.
- .6 Pole mounted Luminaires to be mounted on horizontal mast arms shall be tested for vibration withstanding a cyclic loading of 3G in 3 perpendicular planes (G = Acceleration of Gravity) as per ANSI C136.31
- .7 The housings of exterior mounted luminaires shall be designed to prevent the build-up of water on the top of the housing. Exposed heat sink fins shall be oriented so that water can freely run off the Luminaire, and carry dust and other accumulated debris away from the unit.
- .8 The optical assembly of the Luminaire shall be protected against dust and moisture intrusion per the requirements of IP-66 (minimum) to protect all optical components.
- .9 The electronics/power supply enclosure shall be protected against dust and moisture intrusion per the requirements of IP-65 (minimum)
- .10 Each mounted Luminaire may be furnished with or without a photoelectric unit receptacle (per ANSI 136.10) as per fixture schedule.
- .11 Doors for pole mounted Luminaires shall be hinged and secured to the Luminaire housing. The door shall be secured to the housing in a manner to prevent its accidental opening.
- .12 Field wires connected to exterior mounted Luminaires shall terminate on a barrier type terminal block secured to the housing. The terminal screws shall be captive and equipped with wire grips for conductors up to No. 6. Each terminal position shall be clearly identified.
- .13 The circuit board and power supply shall be contained inside the Luminaire. Electrolytic capacitors used in the power supplies shall be rated for -40°F to 220°F (-40°C to +105°C), long life (> 50,000 hours), and operated at no more than 70% of their rated voltage, and 70% of rated current.
- .10 Materials
 - .1 Housings for exterior mounted Luminaires shall be fabricated from materials that are designed to withstand a 2000-hour salt spray test as specified in ASTM Designation: B117.
 - .2 Each refractor or lens shall be made from UV inhibited high impact plastic such as acrylic and be resistant to scratching.
 - .3 Polymeric materials (if used) of enclosures containing either the power supply or electronic components of the Luminaire shall be made of UL94VO flame retardant materials. The len(s) of the Luminaire are excluded from this requirement.

Part 3 Execution

3.1 INSTALLATION

- .1 Installation shall conform to manufacturer's recommended instructions and details on the drawings (when shown).

- .2 Minimum underground conduit size shall be 1 inch.
- .3 Project anchor bolts 2 inches (50 mm) minimum above base.
- .4 Install all anchor bolts and handhole fasteners with anti-seize compound.
- .5 Install poles plumb. Provide shims or double nuts to adjust plumb.
- .6 Use belt slings or non-chafing ropes to raise and set pre-finished luminaire poles.
- .7 Ground luminaires and poles to suit Ontario Electrical Safety Code requirements.
- .8 Provide separate neutral for each exterior lighting circuit.
- .9 Coordinate with mechanical subcontractor and other trades to avoid conflicts between luminaires, supports and fittings and mechanical equipment and installations.
- .10 Install recessed fixtures to permit removal from below, to gain access to outlet or pre-wired fixture box.
- .11 Support all fixtures installed on or in suspended acoustic tile ceilings, independently of ceiling by means of chain hangers.
- .12 Support suspended fixtures in areas without ceilings directly from building structure by rod hangers and inserts.
- .13 Support suspended fixtures by means of stem hangers supplied as fixture accessories.
- .14 Refer to Section 26 05 00 for additional seismic supports and cross bracing requirements.
- .15 Align fixtures mounted in continuous rows to form a straight, uninterrupted line.
- .16 Align individual fixtures parallel or perpendicular to building lines.
- .17 Verify correct operation of all drivers and luminaires after 100 hours burning time. This contractor shall replace or repair all defective items.

3.2 ADJUSTING AND CLEANING

- .1 Align luminaires and clean lenses and diffusers at completion of Work. Clean paint splatters, dirt, and debris from installed luminaires.
- .2 Aim and adjust luminaires as indicated on Drawings or as directed by the DCC representative.
- .3 Touch up luminaire finish at completion of work.

3.3 INTERFACE WITH OTHER PRODUCTS

- .1 Provide controls as indicated on the plans. Controls shall be compatible with the luminaires/ballasts/drivers being installed.

3.4 FIELD QUALITY CONTROL

- .1 Operate each luminaire after installation and connection. Inspect for proper connection and operation.
- .2 All new luminaires shall be operational at the Substantial Completion of the project.

END OF SECTION

Part 1 General

1.1 ACCEPTABLE MANUFACTURERS:

- .1 Thomas & Betts, Beghelli, Aimlite, Stanpro, Lumacell.

Part 2 Products

2.1 EXIT LAMPS

- .1 CSA-C860 Certified.
- .2 LED type Exit signs in one piece extruded aluminum housing. Finish to be confirmed with the Architect before ordering. Allow for standard colour finish of white/gray or black baked epoxy finish.
- .3 Single face or double face, universal mounting and directional arrows, as required and as indicated on drawings.
- .4 Ceiling, wall or end wall mounting as required and as indicated on drawings.
- .5 Green on White "Running Man" pictogram.
- .6 Self contained module with all electronic power components and LED sources. Power consumption not exceeding 2 watts. LEDs to operate at 120V and provide even illumination. LEDs must have long life with a guarantee of minimum of ten (10) years.
- .7 Refer to Luminaire Schedule on Drawing for types and descriptions of EXIT signs.
- .8 Provide fixtures rated for the environment including dust-tight, weatherproof or classified types as indicated on drawings.

Part 3 Execution

3.1 INSTALLATION

- .1 Install exit lights as indicated in accordance with NBC requirements. Mount Exit Lights on ceiling or wall or suspended stem mount and remove the pertinent knockouts for direction chevrons as indicated.
- .2 Connect fixtures to exit light circuits as indicated.
- .3 Lock breakers in the Panelboards in the ON position.

3.2 TESTING AND COMMISSIONING

- .1 Carry out Testing and Commissioning in accordance with Sections 26 57 01, 26 05 02 and 26 57 03.

END OF SECTION

Part 1 General

1.1 INTENT

- .1 The intent is to demonstrate to the DCC Representative that the power service and distribution system and other systems, have been properly assembled, installed, inspected and tested, comply with design requirements, and are therefore ready for full operation and service in all aspects.
- .2 Testing and commissioning work is divided into three categories:
 - .1 Category 1: Work that must be done by the Specialists, Professional Testing Agency hired and paid by this contractor.
 - .2 Category 2: Work that is not specifically listed as the responsibility of the testing Agency, can be done by the Electrical Subcontractor using qualified and experienced personnel and technicians from the pertinent manufacturers of equipment.
Note: The Electrical Subcontractor may choose to assign this work also to the Testing Agency, at his discretion.
 - .3 Category 3: Testing done in the factory by the manufacturer of the equipment.
- .3 The Electrical Subcontractor shall work with and ensure that all parties carry out their responsibilities whether or not the required work is clearly categorized herein.
- .4 Testing Agency's qualifications shall be as follows:
 - .1 The agency employed for this purpose shall have all necessary qualified personnel, instruments, tools and equipment required for carrying out the activities described.
 - .2 The agency may be either a specialized company offers such services as a primary activity, or alternatively it may be the manufacturer or one of the major systems to be provided; but in the latter case it must be a defined Service Department, sufficiently separate from the manufacturing process to offer independent service and advice.
Testing Agency may be any one of the following:
 - .1 Cutler Hammer – Field Service Division
 - .2 Siemens Canada – Field Service Division
 - .3 Schneider Electric – Field Service Division
- .5 Testing Agency's Scope of Work shall be as follows:
 - .1 Complete Short-Circuit, Coordination and Arc Flash Study. Refer to Section 26 24 00.
 - .2 The Testing Agency shall assist this Subcontractor by demonstrating to the DCC Representative the systems/work listed above, when completed, have been properly assembled, installed, inspected and testing, and are therefore ready for full operation and service in all respects.
 - .3 The Testing Agency shall coordinate and participate in all specified factory and field tests of equipment and systems.
 - .4 The Testing Agency shall review all manufacturer's shop drawings and offer comments to ensure that the correct protective elements will be provided. Submit queries to the DCC Representative and Consultant for clarifications.
 - .5 The details of Testing, Commissioning and Demonstration Seminars are covered later in Section 26 57 03.
 - .6 A brief overview, sequence and coordination of activities of the Testing Agency is as follows:
 - .1 Carry out pre-startup checks.

- .2 Carry out performance tests, adjusting and balancing in conjunction with the manufacturer's representatives
- .3 Submit test results and reports complete with comments on acceptability and recommendations for any required corrective measures.

1.2 RELATED WORK

- .1 Section 26 57 02 – Systems Testing
- .2 Section 26 57 03 – Equipment and Systems Demonstration and Instruction

1.3 SCOPE

- .1 Testing and Commissioning shall cover the following aspects:
 - .1 Component Verification: Verification of each electrical component's compliance with specifications. Information to be filled in on "PI" Product Information Forms **(Equipment Checklists)**.
 - .2 Component Testing: Testing of each electrical component to confirm compliance with performance requirements. Information to be filled in on "PV" Performance Verification Forms **(Pre-Functional Checklists and Test Certificates/Reports)**.
 - .3 System Verification: The intent is to test each electrical system to verify that the installed components are operating properly as a system and meet the specified requirements. This testing is to supplement, but not duplicate the testing already carried out for component verification and component testing. Refer to Section 26 57 02. **(System Integration Checklists)**.
 - .4 Demonstration and Instruction: Conduct sessions to familiarize facility operation and maintenance personnel with electrical systems and their operation and maintenance. Refer to Section 26 57 03.

1.4 VERIFICATION FORMS

- .1 Develop project specific verification forms for verification of components and systems. Refer to Section 26 57 02 for System Verification requirements. Prepare the forms in conjunction with the manufacturer and the testing agency(ies). Complete the verification forms for all tests and verifications. The format of the manufacturers' standard forms modified to include the requirements indicated herein, are acceptable. The forms shall cover Product Information "PI" and "Performance Verification".
- .2 "PI" – Product Information Forms **(Equipment Checklists)**: The purpose of the Equipment Checklists is to record, for the purposes of creating a maintenance/inventory database, at least the following:
 - .1 Nameplate data of the component
 - .2 Pertinent shop drawing information
 - .3 Results of visual/physical examination of component for acceptance on-site
 - .4 Pre-start-up checks
 - .5 Pertinent operations data
 - .6 Additional items as required and as indicated
- .3 "PV" – Product Verification Forms **(Pre-Functional Checklists and Test Certificates/Reports)**: The purpose of the Pre-Functional Checklists and Test Certificates/Reports is to record the results of component tests.

- .4 System verification forms (**System Integration Checklists**): The purpose of the System Verification forms is to record the results of the test performed to verify that the installed components of each electrical system are operating properly as a system and meet the specified requirements.
- .5 Prepare and complete Equipment and Pre-Functional Checklists for the individual components listed below and as required for additional items:
 - .1 Circuit Breakers and Panelboards
 - .2 Dry Type Transformers
 - .3 Fire Alarm System
 - .4 Lighting and Controls

1.5 SUBMITTALS

- .1 Submit the required number of copies as per Section 26 05 00 for the following:
 - .1 All proposed tests
 - .2 All proposed test instruments
 - .3 All proposed check sheets and test record forms
- .2 Within a week of award of this work, submit a detailed schedule of activities co-ordinate with the Construction Schedule.
- .3 Submit all test results, signed and sealed by the Professional Engineer in charge of Testing. Include comments and recommendations for required corrective measures, if any for review by DCC Representative. These reports shall be submitted within one week following the completion of each test segment.

1.6 QUALITY ASSURANCE

- .1 All starting, testing procedure shall be in accordance with:
 - .1 Applicable CSA, IEEE, IPCEA, EEMAC, ASTM and CAN/ULC Standards
 - .2 Manufacturer's published instructions. Prior to testing components or systems, obtain and review manufacturer's installation, operation, starting instructions and in particular any testing constraints/cautionary measures that must be observed.
- .2 Arrange and pay for qualified manufacturer's representatives to supervise starting and testing of electrical components and systems, as required:

Part 2 Component Testing

2.1 PRIOR TO ENERGIZING

- .1 Confirm component's nameplate data with characteristics of power supply.
- .2 Verify supply voltage and phase rotation.
- .3 Ensure all testing as specified has been completed and deficiencies have been corrected.
- .4 Close and open all devices to ensure proper mechanical operation.
- .5 Megger all feeders and record results on approved verification forms.

2.2 LOAD BALANCING

- .1 Three to six months after the installation has been completed, carry out the following work at peak load hours.
 - .1 Measure load balance on all feeders at distribution centres and panel boards with normal loads. If load unbalanced exceeds 15%, reconnect circuits to obtain the best possible balance of current between phases. Revise panel board directories and wiring identification accordingly.
 - .2 Measure phase voltages at switchgear, main switches, distribution centres and panel boards with normal loads. Adjust transformer taps, where required, to within 2% of rated voltage of components.
- .2 Submit, at completion of work, a report listing phase and neutral currents on switchgear, main switches, distribution panels, panelboards and transformers, operating under normal loads. State hour and data on which each load was measured and voltage at time of test. Carry out required adjustments, balancing and corrective work.

2.3 INSULATION RESISTANCE

- .1 Megger all circuits, feeders and components up to 350 V with a 500 V instrument.
- .2 Megger all 350-600 V circuits, feeders and components with a 1000 V instrument.
- .3 Check insulation resistance to ground before energizing.
- .4 Provide instruments, meters, equipment and personnel required for conducting tests during and at conclusion of project.
- .5 Record the results in a suitable format and submit to the DCC Representative for review.
- .6 Distribution equipment test voltages and minimum insulation resistances shall be as follows:

Voltage Rating	Minimum DC Test Voltage	Minimum Insulation Resistance in Meg-ohms
0 – 250 V	500 V	50
250 – 600 V	1000 V	100
601 – 5000 V	2500 V	1000
Over 5000 V	2500 V	5000

2.4 COORDINATION OF PROTECTIVE DEVICES

- .1 Ensure circuit protective devices such as overcurrent trip relays, fuses are installed to values and settings determined by the Coordination Study.

2.5 MOULDED CASE CIRCUIT BREAKER UP TO 150A

- .1 Visual and mechanical inspection as for the larger moulded case breakers.
- .2 Mechanical function test.
- .3 Set all units with adjustable magnetic trip units.
- .4 Record all observations, data and test results on the appropriate checklist.

2.6 GROUND FAULT CIRCUIT BREAKER

- .1 Visual and mechanical inspection as for the moulded case breakers.
- .2 Mechanical function test.
- .3 Demonstrate operation on simulated ground fault tests.

- .4 Record all observations, data and test results on the appropriate checklist.

2.7 PROTECTIVE RELAYING

- .1 Set and test protective relays to the settings provided in the coordination study. The manufacturer's instructions for the specific relay must always be used for information concerning connections, adjustments, testing, repairs, timing and data.

2.8 DISCONNECT SWITCHES FUSED AND UNFUSED

- .1 Visual and Mechanical Inspection:
 - .1 Check physical, electrical and mechanical condition. Inspect for cracks or other defects.
 - .2 Compare equipment nameplate data with latest contractual documents/requirements. Operate switch to ensure smooth operation.
 - .3 Check tightness of connections using calibrated torque wrench.
 - .4 Check blade alignment.
 - .5 Check each fuse holder for adequate mechanical support of each fuse.
 - .6 Check all electrical and mechanical interlocks.
 - .7 Check proper phase barrier materials and installation.
 - .8 Inspect all indicating devices for proper operation.
 - .9 Clean entire switch using approved methods and materials.
 - .10 Lubricate to manufacturer's recommendations.
 - .11 Exercise all active components.
- .2 Record all observations, data and test results on the appropriate checklist.

2.9 PANELBOARDS

- .1 For Distribution, Power and Lighting Panels:
 - .1 Conduct load balancing as defined in this section.
 - .2 Carry out visual inspection.
 - .3 Torque all bus connections using calibrated torque wrench.
 - .4 Record all observations, data and test results on the appropriate checklist.

2.10 WIRING AND CABLES

- .1 Test all conductors, including those at main switches, splitters, distribution centres and panelboards for insulation resistance to ground (megger test).
- .2 Test service grounding conductors for ground resistance.
- .3 Provide DCC Representative with list of test results on approved verification form showing location at which each test was made, circuit tested and results of each test.
- .4 Remove and replace entire length of cable if cable fails to meet any of the test criteria.

2.11 GROUNDING

- .1 Perform ground continuity and resistance tests using method appropriate to site conditions and to approval of DCC Representative and local authority having jurisdiction over installation.
- .2 Perform tests energizing electrical distribution.
- .3 Disconnect ground fault indicator during tests, where applicable.

- .4 Provide test report documenting successful test results.

2.12 MOTORS

- .1 Prior to starting motors:
 - .1 Confirm motor nameplate data and motor starter heater overloads, setting of MCPs and sizing of fuses.
 - .2 Verify rotation.
 - .3 Ensure disconnects are installed.
 - .4 Confirm labeling of motors, disconnects and starters.

2.13 FIRE ALARM SYSTEM

- .1 The work listed below shall be carried out for the fire alarm system installation.
- .2 Inspect installation of all components for compliance with the manufacturer's instruction and recommendations.
- .3 Verify the components comply with the ULC standards for fire alarm devices.
- .4 Verify the installation of the fire alarm systems comply with CAN4-S524, Standard for the Installation of Fire Alarm Systems.
- .5 Check wiring is properly terminated and identified.
- .6 In conjunction with the manufacturer, test and verify the system in accordance with:
 - .1 CAN/ULC-S537-04, Standard for Verification of Fire Alarm System Installations.
 - .2 Requirements of authorities having jurisdiction.
- .7 Arrange for authorities having jurisdiction to witness and approve testing of the Fire Alarm System.
- .8 Prepare, complete, sign and submit all checklists.
- .9 Testing and verification to include but not necessarily be limited to the following. Include also for all items required by the pertinent Canadian Standards that may not be in the following list:
 - .1 At the completion of the installation of all system equipment and devices and after the connection to all motors, fans, ventilation and smoke controls, test and verify the entire system using the supervisory services of the approved independent testing company, under the supervision of a registered professional engineer.
 - .2 After the testing and verification task is completed, and all deficiencies rectified, notify the DCC Representative and in their presence demonstrate the proper functioning of the entire system.
 - .3 The purpose of the verification procedure for the system is to make certain that all equipment operates as intended. Provide upon completion of the verification procedures, an approved certificate of verification to the DCC Representative. Display one copy near the control panel and return a copy with the system documentation. Provide an equipment schedule, listing each device and showing confirmation that it was verified.
 - .4 The verifying agent is to be a member in good financial and practice standing with the Canadian Fire Alarm Association (C.F.A.A.) and shall have the work carried out under the supervision of a registered professional engineer.
 - .5 Inspect and test the wiring to every device to verify that removal of the device or breaking wire will cause the trouble signals to operation properly. Verify that trouble signals operate on open circuit, short circuit, ground fault or the removal of any plug-in

- component. Inspect wiring to ensure that individual terminations have been provided for all conductors and that where applicable correct polarities have been observed.
- .6 Inspect all equipment installed as part of the system for visual damage or tempering which might interfere with its intended operation.
 - .7 Test devices which are field adjustable to ensure that their settings are acceptable under ambient conditions at the location of installation.
 - .8 Operate each and every manual initiating device to verify their proper operation.
 - .9 Use a heat source to test the operation of each and every heat detector, resettable or self-restoring.
 - .10 Each and every heat detector, non-resettable: simulate the detectors operation by shoring terminals on the detector base.
 - .11 Each and every smoke detector, area type: Test detector sensitivity according to the manufacturer's recommendations. Test detector operation by introducing "simulated smoke" into the detector.
 - .12 Test all audible signal appliances for acceptable operation. Make tests to determine that the signal is audible throughout the building above normal ambient noise. Make tests to verify that adequate power is available from both normal and standby sources under the maximum system load.
 - .13 Make installation of additional signals or revisions to power sources to ensure audibility prior to completion of the inspection before a certificate of verification can be issued.
 - .14 Test annunciators to ensure proper operation, correct voltage, correct zoning and visibility of all legends.
 - .15 Inspect the system power supply to ensure that it is properly fused, locked away from unauthorized interruption and adequately sized. A rated load cycle is the total energy consumed by supervisory current plus supervisory alarm signal current for 24 hours followed by 30 minutes of full evacuation alarm operation.
 - .16 Inspect battery units for protection from accidental damage and for adequate ventilation. Connect batteries permanently to a properly fused charging circuit dedicated to the alarm system batteries.
 - .17 Test all control equipment for acceptable operation. Make an inspection and test of all cable terminals, plus connections, plug-in circuits, lamp sockets and controls to confirm that their mechanical and electrical connections and mounting are acceptable, and where applicable to confirm their electrical supervision.
 - .18 Verify that field wiring is terminated on a single conductor per terminal basis.
 - .19 Test all lamps and indicators for acceptable operation. Operate all control functions to verify correct response. Perform simulation of open circuits and ground fault on all relevant components to confirm proper trouble circuit response.
 - .20 Test ancillary equipment connections for proper operation. Inspect such equipment to ensure that faults in it will not interfere with alarm system operation.
 - .21 Test the remote central station connection for acceptable operation.
- .10 On completion of all tests and verification provide the DCC Representative with a certificate of test and verification and proof of liability insurance for tests and verification.
 - .11 Include all costs involved in this inspection for both the manufacturer and the approved testing agent and the electrical contractor's work.
 - .12 Contractor to provide the required electricians to the testing agent throughout the testing period. Also, the contractor shall provide the testing agent with all equipment, etc. necessary to perform the testing and verification.

2.14 TRANSFORMERS (DRY-TYPE, AIR-COOLED, LOW-VOLTAGE, SMALL)

- .1 Visual and Mechanical Inspections:
 - .1 Compare equipment nameplate data with drawings and specifications.
 - .2 Inspect physical and mechanical condition.
 - .3 Inspect anchorage, alignment, and grounding.
 - .4 Verify that resilient mounts are free and that any shipping brackets have been removed.
 - .5 Verify the unit is clean.
 - .6 Inspect bolted electrical connections for high resistance using a low-resistance ohmmeter.
 - .7 Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method in accordance with manufacturer's published data.
 - .8 Verify that tap connections are as specified.
- .2 Electrical Tests.
 - .1 Perform resistance measurements through bolted connections with a low-resistance ohmmeter.
 - .2 Provide factory test results for:
 - .1 Insulation-resistance tests, winding-to-winding and each winding-to-ground.
 - .2 Turns-ratio tests at all tap positions.
 - .3 Verify correct secondary voltage phase-to-phase and phase-to-neutral after energization and prior to loading.

END OF SECTION

Part 1 General

1.1 INTENT

- .1 Inspect, start and test each electrical system to verify that the installed components are operating properly as a system and meet the specified requirements. The intent is to supplement, but not duplicate the testing already carried out for component testing. For example, the Power Distribution System consists of components such as Main Switch/Breaker, Distribution Panel, Step-Down Transformer, Branch Circuit Panel, etc., which would already have been tested as components. As a part of the system testing to be carried out, the intent is to verify that these are correctly connected together and operate correctly as a system. Note, that before System tests can be performed, all components of the system must have been inspected, tested and found to be working satisfactorily in accordance with the specified requirements. Prepare, complete and submit System Verification forms (**System Integration Checklists**).

1.2 RELATED WORK

- .1 Section 26 57 03 – Equipment and Systems Demonstration and Instruction.

Part 2 Products

2.1 POWER DISTRIBUTION

- .1 Verify the Power Distribution System operation to verify all operational aspects as specified, including the following:
 - .1 The correct relationships between all source switches, breakers and loads controlled as follows. This shall apply throughout except for branch circuits. The source – load relationships to be established shall include:
 - .1 Main switch/breaker to Main distribution panel
 - .2 Distribution panel to step-down transformer.
 - .3 Step-down transformer to Branch panel
 - .4 Branch panel to equipment.

2.2 MOTOR CONTROLS

- .1 Verify related component start-up tests have been completed and approved by the DCC Representative.
- .2 Conduct systems testing per this section and record test information on verification forms. Submit copies to the DCC Representative for approval following testing.
- .3 Verify the Motor Control Systems' operation to verify all operational aspects as specified, including the following:
 - .1 The correct relationships between starters and the motors controlled.
 - .2 Remote control operations.
 - .3 Verify all operational/interface aspects including interface aspects with the Fire Alarm System.

2.3 FIRE ALARM SYSTEM

- .1 Verify related component start-up tests outlined in Section 26 57 01 have been completed and approved by the DCC Representative.
- .2 Conduct systems testing per this Section and record test information on verification forms. Submit copies to the DCC Representative for approval following testing.
- .3 Verify interface with the following systems (where applicable) when the Fire Alarm System is complete in all aspects, verified, tested and fully operational and signed off:
 - .1 Mechanical Equipment, e.g. fans, make-up-air units
 - .2 Security System
 - .3 Sprinkler System/Suppression System
 - .4 BAS System
 - .5 Elevator
 - .6 Door hold opens
 - .7 Request-to-exit doors
 - .8 Maglocks
 - .9 Smoke Dampers
 - .10 Electric Door Strikes
 - .11 Sprinkler/Suppression System switches and valves

END OF SECTION

Part 1 General

1.1 RELATED WORK

- .1 Section 26 57 01 - Testing Requirements and Component Testing.
- .2 Section 26 57 02 - Systems Testing.

Part 2 System Demonstration and Instruction

2.1 INTENT

- .1 Provide demonstration and instruction sessions to familiarize facility operation and maintenance personnel with electrical systems and their operation and maintenance.
- .2 Do not commence any demonstration and instruction work until all electrical systems are complete and proven operational.
- .3 Provide hard copies as well as electronic copies of all instructions and information given to the facility staff during the course of these sessions. Include this information in the operating and maintenance manuals.
- .4 Instruct and demonstrate the method of preparation of all equipment for seasonal service.
- .5 If, in the opinion of the Contractor, staff instructed on the operation and maintenance of the electrical systems have not assimilated the instructions during the instructional period and are therefore not qualified to assume responsibility for the operation of the electrical system, notify the DCC Representative in writing.
- .6 Arrange and pay for appropriately qualified manufacturer's representatives to provide or assist in providing electrical equipment and systems demonstration and instruction as specified herein.
- .7 Provide demonstration and instruction seminars for the systems listed below, where appropriate:
 - .1 Fire Alarm System
- .8 Chair demonstration and instruction sessions, and establish agendas for demonstration and instruction sessions in conjunction with the DCC Representative.
- .9 All demonstrations and seminars shall be scheduled during working weekdays between the hours 8:30 am to 11:30 am and 1:00 pm to 4:00 pm.
- .10 Thirty (30) days prior to the proposed demonstration and seminar dates submit proposed agenda and seminar/demonstration outline to the DCC Representative. Include the following information:
 - .1 Equipment and systems which will be included
 - .2 Name of companies and representatives conducting seminar/demonstration
 - .3 Outline of each seminar/demonstration's content
- .11 The system demonstration part of the seminar shall cover at least the following aspects:
 - .1 Start-up and shutdown
 - .2 Sequence of operation, various modes of operation
 - .3 Scheduled and preventative maintenance
 - .4 Troubleshooting
- .12 The system instruction part of the seminar shall cover at least the following aspects:

- .1 An overview of how the system is intended to operate
- .2 Description of the design parameters, constraints and operational requirements
- .3 Description of the system operation strategies
- .4 Information to help in identifying and troubleshooting system problems
- .13 The equipment instruction part of the seminar shall cover at least the following aspects:
 - .1 Explanation of how equipment operates
 - .2 Recommended preventative and routine maintenance
- .14 Include for multiple sessions for each system demonstration and instruction seminars to ensure that the facility maintenance personnel have been provided with complete and proper information and instructions.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

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

1.2 DEFINITIONS

- .1 Refer to TIA/EIA-598-C, Annex A for definitions of terms: optical-fiber interconnect, distribution, and breakout cables.

1.3 REFERENCE STANDARDS

- .1 CSA Group (CSA)
 - .1 CSA-C22.2 No. 214-02, Communications Cables (Bi-National standard with UL 444).
 - .2 CSA-C22.2 No. 232-M1988(R2004) , Optical Fiber Cables.
- .2 Telecommunications Industry Association (TIA)/Electronic Industries Alliance (EIA)
 - .1 TIA/EIA-568-B.1-(2001), Commercial Building Telecommunications Cabling Standard, Part 1: General Requirements.
 - .2 TIA/EIA-568-B.2-(2001), Commercial Building Telecommunications Cabling Standard, Part 2: Balanced Twisted-Pair Cabling Components.
 - .3 TIA/EIA-606-A-(2002), Administration Standard for the Commercial Telecommunications Infrastructure.
 - .4 TIA TSB-140-2004, Telecommunications Systems Bulletin - Additional Guidelines for Field-Testing Length, Loss and Polarity of Optical Fiber Cabling Systems.

1.4 SYSTEM DESCRIPTION

- .1 Provide data drops in locations shown on drawings including all conduits and wiring back of new comms duct bank to connect the existing Glycol Building (B667) to MH N31 (east of Building B526). Terminate all connections and test devices and commission system to ensure correct functionality.

1.5 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 As-built Records and Drawings:
 - .1 Provide Microsoft Access database reflecting cable installation and cross-connections.
 - .2 Provide electronic drawings in AutoCAD 2024 format depicting all construction.
 - .3 Provide two (2) bound complete hard-copy sets of as-built records to the DCC Representative.

1.6 QUALITY ASSURANCE

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

1.7 DELIVERY, STORAGE AND HANDLING

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

Part 2 Products

2.1 FOUR-PAIR 100 W BALANCED TWISTED PAIR CABLE

- .1 Four-pair, 100 ohm balanced unshielded-twisted-pair (UTP) cable, flame test classification FT6 to: CSA-C22.2 No. 214, Category 6 (Cat 6) to: TIA/EIA-568 -B.2.

2.2 MULTI-PAIR 100 W BALANCED TWISTED PAIR CABLE

- .1 100 ohm, 24 pairs, sheath consists of thermoplastic jacket with underlying metallic shield, Category 3 to: TIA/EIA-568 -B.2, flame test classification FT4 or MPG or CMG to: CSA-C22.2 No. 214

2.3 WORK AREA UTP 4-PAIR MODULAR JACK

- .1 Eight-position modular jack "RJ-45", type T568A Category 6 to: TIA/EIA-568-B.2:
 - .1 In self-contained surface-mount box. Install multiple jacks per box.
 - .2 Mounted in compatible single or multi-gang faceplate, flush entry.

2.4 TERMINATION AND CROSS-CONNECTION HARDWARE FOR UTP

- .1 IDC Terminal strips, 25 pair, for terminating 4 pair 100 W balanced twisted pair cables and supporting cross-connections using jumper wires or compatible plug-ended patch cords: Category 6 to: TIA/EIA-568 -B.2.
- .2 Mount or block for housing 12 IDC terminal strips, mounted on wall rack or cabinet.
 - .1 Distribution rings or channels capable of externally mating with the above mount for managing cross-connection wires.
- .3 Patch panel, 24 ports:
 - .1 Each port equipped with "RJ-45" jacks, type T568A Category 6 to: TIA/EIA-568 -B.2.
 - .2 Horizontal cable-management unit for every 24 ports.
- .4 Consolidation point, terminates 12 UTP horizontal cables from telecommunications room on IDC terminations. Cables extending to work areas terminate on RJ-45 jacks, type T568A. Category 6 to: TIA/EIA-568 -B.2.

2.5 UTP CROSS-CONNECT WIRE

- .1 Category 6, 4 pairs to: TIA/EIA-568 -B.2.

2.6 UTP PATCH CORDS

- .1 0.3 and 1.5 metres long, with factory-installed male plug at one end to mate with "RJ-45" jack and with factory-installed male plug at other end to mate with "RJ-45" jack Category 6, 4 pairs to: TIA/EIA-568 -B.2.

2.7 UTP EQUIPMENT CABLE

- .1 4 pair "pigtail", length as required, with factory-installed male plug on one end to mate with "RJ-45" jack and other end equipped with factory-installed male plug to mate with "RJ-45" jack or terminal strip: Category 6 to: TIA/EIA-568 -B.2.

2.8 UTP WORK AREA CORDS

- .1 3 metres long, each end equipped with "RJ-45" plug Category 6 to: TIA/EIA-568 -B.2.

Part 3 Execution

3.1 INSTALLATION OF TERMINATION AND CROSS-CONNECT HARDWARE

- .1 Install termination and cross-connect hardware on wall or in cabinet as indicated and according to manufacturers' instructions. Identify and label as indicated to: TIA/EIA-606 -A.
- .2 Install consolidation points, as indicated according to manufacturer's instructions. Identify and label as indicated to: TIA/EIA-606-A.

3.2 INSTALLATION OF HORIZONTAL DISTRIBUTION CABLES

- .1 Install horizontal cables as indicated in conduits or cable trays from telecommunication rooms to consolidation point or individual work-area jacks. Identify and label as indicated to: TIA/EIA-606 -A.
- .2 Support horizontal cables at intervals not exceeding 2 metres.
 - .1 Where raceways are used to distribute cables to each zone, provide supplementary "J" hooks to support cables at intervals not exceeding 2 metres.
- .3 Install horizontal cables from consolidation point to individual work-area jacks.
 - .1 Provide supplementary "J" hooks to support cables at intervals not exceeding 2 metres.
 - .2 Identify and label as indicated to: TIA/EIA-606 -A.
- .4 Terminate horizontal cables in telecommunications room and at consolidation point or individual work-area jacks.
 - .1 Identify and label as indicated to: TIA/EIA-606 -A.
- .5 Coil spare cables and store in ceiling space in zone.

- .6 Harness slack cable in cabinets, racks, and wall-mounted termination and cross-connection hardware.

3.3 INSTALLATION OF BACKBONE CABLES

- .1 Install backbone cables from telecommunications room or area to main terminal/equipment room (MT/ER) as indicated and according to manufacturers' instructions.
 - .1 Identify and label as indicated to: TIA/EIA-606 -A.
- .2 Where indicated, install backbone cables from MT/ER to carrier demarcation point in Entrance Room according to manufacturer's instructions.
 - .1 Identify and label as indicated to: TIA/EIA-606 -A.

3.4 INSTALLATION OF EQUIPMENT CABLES

- .1 Install equipment cables from equipment, terminal strips or patch panel as indicated.
 - .1 Identify and label as indicated to: TIA/EIA-606 -A.
 - .2 Label Tape and Type Colour
 - .3 Use strong adhesive tape with a white background and black text.
 - .4 CAT6 Jacks
 - .5 Label or re-label as required, all Cat6 data jacks as follows: x-yyy, where x is data closet 1, 2, 3, or 4, and -yyy is the data drop number, i.e. 1-001, 2-104, 3-013, 4-077. Leading zeros must be included.
 - .6 CAT6 Wireless Jacks
 - .7 Label all wireless Cat6 data jacks as follows: Wx-yyy, where W stands for wireless, x is data closet 1, 2, 3, or 4, and -yyy is the data drop number, i.e. W1-001, W2-104, W3-013, W4-077. Leading zeros must be included
 - .8 CAT6 UTP Patch Panel
 - .9 Each CAT6 UTP Patch Panel RJ45 jack to be labeled as follows: x-yyy, where x is the data closet and yyy matches the jack number at the other end of the UTP cable.
 - .10 CAT6 UTP Wireless Patch Panel
 - .11 Each wireless CAT6 UTP Patch Panel RJ45 jack to be labeled as follows: Wx-yyy, where W stands for wireless, x is the data closet and yyy matches the jack number at the other end of the CAT6 UTP cable.

3.5 IMPLEMENT CROSS-CONNECTIONS

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

3.6 FIELD QUALITY CONTROL

- .1 Test horizontal UTP cables as specified below and correct deficiencies provide record of results as hard copy and electronic record.
 - .1 Perform tests for Permanent Link on installed cables, including spares:
 - .1 Category 6 using certified level III tester to: TIA/EIA-568 -B.2.

- .2 Perform tests for Channel on 20% of cross-connected data horizontal cabling installed from telecommunications room, including shortest and longest drops from telecommunications room: should more than 5% of tested cables fail, test remaining cross-connected data cables.
 - .1 Category 6 using certified level III tester to: TIA/EIA-568 -B.2.
- .2 Test backbone UTP cables as specified below and correct deficiencies: provide record of results as hard copy and electronic record.
 - .1 Perform tests for Permanent Link on 4-pair cables:
 - .1 Category 6 using certified level III tester to: TIA/EIA-568 -B.2.
 - .2 Perform Wire Map tests on multi-pair UTP cables to: TIA/EIA-568 -B.1.

END OF SECTION

Part 1 General

1.1 RELATED WORK

- .1 Section 21 13 13 – Wet Pipe Fire Suppression Sprinklers.
- .2 Section 26 05 21 – Wire and Cables 0-1000 V.
- .3 Section 26 05 34 – Conduits, Conduit Fastenings and Conduit Fittings.

1.2 REFERENCES

- .1 CAN/ULC S524-2006-AM1, Installation of Fire Alarm Systems.
- .2 CAN/ULC-S525-2007, Audible Signal Appliances for Fire Alarm.
- .3 CAN/ULC-S526-2007, Visual Signal Appliances, Fire Alarm.
- .4 CAN/ULC-S527-2011, Control Units, Fire Alarm.
- .5 CAN/ULC-S528-2005, Manual Pull Stations.
- .6 CAN/ULC-S529-2009, Smoke Detectors, Fire Alarm.
- .7 CAN/ULC-S530-M91, Heat Actuated Fire Detectors, Fire Alarm.
- .8 CAN/ULC-S531-2002, Smoke Alarms.
- .9 CAN/ULC-S536-2004, Inspection and Testing of Fire Alarm Systems.
- .10 CAN/ULC-S537-2004, Verification of Fire Alarm Systems.
- .11 OBC, Ontario Building Code, Current Edition.
- .12 Canada Labour Code.

1.3 SCOPE OF WORK

- .1 This contractor shall supply and install all equipment and accessories required for a complete electrically supervised, non-coded, zoned fire alarm system as described herein and shown on the drawings for the New Pumphouse. This includes a small new Addressable Fire Alarm Control Panel, initiation and notification circuits, devices, conduits, wiring, underground ducts and a wiring interconnection to the existing Siemens Fire Alarm Control Panel located in the adjacent Glycol Building 667. Minimum conditions to be reported back to the Fire Alarm Control Panel in Glycol Building 667 are "pump house alarm" and "pump house trouble."
- .2 On completion of the installation, the manufacturer's representative shall check the system for proper installation and operation of the system and issue an inspection certificate.
- .3 This contractor shall retain an independent qualified contractor to verify the system on the completion of the installation. The independent contractor and the technician performing the system verification shall be registered with the Canadian Fire Alarm Association.

1.4 RELATED WORK BY OTHER DIVISIONS

- .1 Equipment supplied and installed by other Divisions, to be wired into the fire alarm system by this contractor shall include:
 - .1 Make Up Air Units, where applicable
 - .2 Electric door strikes
 - .3 Elevator

- .4 BAS
- .5 Hold open devices
- .6 Maglock
- .7 Smoke Dampers
- .2 The following equipment to be supplied and installed under Division 21, to be wired into the fire alarm system by this contractor:
 - .1 Flow switches
 - .2 Pressure switches
 - .3 Tamper Switches

1.5 MATERIALS STANDARD

- .1 All system components to be ULC Listed for use as part of fire alarm systems and be of one manufacturer.

1.6 SYSTEM DESCRIPTION

- .1 Fully supervised, addressable, microprocessor-based, fire alarm system.
- .2 System to carry out fire alarm and protection functions: including receiving alarm signals; initiating general alarm; supervising components and wiring; actuating annunciators and auxiliary functions; initiating trouble signals and alarm initiating signals to monitoring agency.
- .3 Zoned, non-coded, single stage.
- .4 Modular in design to allow for a minimum of 25% future expansion.
- .5 System shall have a minimum of one (1) addressable loop with the ability to add additional loop(s).
- .6 System to include:
 - .1 Central Control Unit (CCU) in separate enclosure with power supply, stand-by batteries, central processor with microprocessor and logic interface, main system memory, input-output interfaces for alarm receiving, annunciation/display, and program control/signaling.
 - .2 Power supplies.
 - .3 Initiating/input circuits.
 - .4 Output circuits.
 - .5 Auxiliary circuits.
 - .6 Wiring.
 - .7 Manual and automatic initiating devices
 - .8 Audible and visual signaling devices.
 - .9 End-of-line devices where required.
 - .10 Local annunciator.
 - .11 Event log memory chip.
 - .12 Historic event recorder.
 - .13 Annunciation of fire alarms on the main and remote alpha-numeric annunciators shall be programmed to indicate the pertinent area zone in which it is located. The area zones shall be required and as shown on drawings.

- .14 Provide passive graphic drawings (floor plans) that show the fire alarm area zones and other pertinent items that will speed up the identification of the location of the fire and shorten the response time. Zone identification on the alpha-numeric readout, and passive graphic drawings must be identical. Passive graphic drawing to be mounted behind a clear acrylic shield in a brushed aluminum frame. Size graphic to suit wall space and the approval of the DCC Representative and the Consultant. Allow for correcting the graphic wording and the panel programming to suit the new layout after the approval of the DCC Representative and the local authority having jurisdiction.
- .15 The equipment and devices to be provided shall be compatible with the existing Siemens system on the base (Conventional Seimens TXL-1000).

1.7 REQUIREMENTS OF REGULATORY AGENCIES

- .1 System components: Listed by ULC and comply with applicable provisions of the National Building Code, Ontario Building Code and Local Building Code, and meet requirements of local authority having jurisdiction.

1.8 SHOP DRAWINGS

- .1 Submit shop drawings in accordance with Section 26 05 00 – Electrical General Provisions.

1.9 SYSTEM VERIFICATION AND SUBMITTALS

- .1 At the completion of the installation, provide the following letters of certification:
 - .1 Manufacturer to submit (by way of the contractor) to DCC Representative the following:
 - .1 Copy of inspection technician's report showing location of each device and certifying test results of each device.
 - .2 A signed certificate stating that system has been installed and is operating satisfactorily and meets all Codes and Standards as listed above.
 - .2 Contractor to submit the following:
 - .1 A signed certificate by the Owner and Contractor stating that the Owner has been instructed as to the operation and configuration of the system and maintenance procedures.
 - .3 Both letters of certification shall be on company letterhead and signed by an authorized officer of the company. Each letter shall indicate the following:
 - .1 The name of the system
 - .2 The name of the facility
 - .3 The correct address of the facility
 - .4 A statement that the system has been installed and that it operates in accordance with the drawings and specifications and that the system was found to be in proper operating conditions
- .2 Manufacturer shall test complete system at the end of their twelve (12) month guarantee period and submit to Owner and DCC Representative, results in the form of a signed certificate.

1.10 OPERATION AND MAINTENANCE DATA

- .1 Provide operation and maintenance data for fire alarm system for incorporation into manual specified in Section 26 05 00 – Electrical General Provisions.
- .2 Include:

- .1 Instructions for complete fire alarm system to permit effective operation and maintenance.
- .2 Technical data – illustrated parts lists with parts catalogue numbers.
- .3 Copy of approved shop drawings with corrections completed and marks removed except review stamps.
- .4 List of recommended spare parts for system.
- .5 Copies of all System Verifications and Submittals documents.

1.11 MAINTENANCE MANUALS

- .1 Provide maintenance materials in accordance with Section 26 05 00 – Electrical General Provisions.
- .2 Include:
 - .1 Provide a list of recommended spare parts. In the case of a standard spare kit being provided, the contents of the spare kit shall be listed.

1.12 MAINTENANCE

- .1 Provide one (1) year's free maintenance with two (2) inspections by manufacturer during warranty period. Inspection tests to confirm to CAN/ULC-S536. Submit inspection report to Owner. The start of the guarantee period is as specified in Section 26 05 00 – Electrical General Provisions.

1.13 TRAINING

- .1 Arrange and pay for on-site training and demonstrations by fire alarm system manufacturer to train operational personnel in use and maintenance of fire alarm system. Allow for a sufficient time period of training (minimum four (4) hours).
- .2 System manufacturer shall provide qualified training technicians to give instruction and/or training to the operating and maintenance personnel in all aspects of the system controls, operations and minor troubleshooting.
- .3 Instructions to operating and maintenance personnel: The manufacturer shall provide the services of competent instructors who will provide full instruction to designated personnel in the adjustment, operation and maintenance, including pertinent safety requirements of the equipment and system specified. The training shall be oriented toward the system installed rather than being a general training course. Instructors shall be thoroughly familiar with all aspects of the subject matter they are to teach.

Part 2 Products

2.1 MATERIALS

- .1 Equipment and devices: ULC Listed and labeled and supplied by single manufacturer.

2.2 SYSTEM OPERATION: SINGLE STAGE – SIGNALS ONLY

- .1 Actuation of any alarm initiating device to:
 - .1 Cause electronic latch to lock-in alarm state at the Fire Alarm panel.
 - .2 The red alarm LED's in the control panel and annunciator panel(s) shall be turned "ON"
 - .3 Indicate zone of alarm at Fire Alarm control panel annunciator and the remote annunciator panel(s) using zone LED's and/or on the alpha numeric displays.

- .4 Cause audible signaling devices to sound continuously and visual device to flash continuously throughout building, at the Fire Alarm control panel and at the remote annunciator panel(s).
- .5 Activate the common alarm contact and transit signal to the approved monitoring agency.
- .6 Cause air conditioning and ventilation fans to shut down or to function to provide required control of smoke movement.
- .7 Cause the operation of smoke control dampers.
- .8 Cause fire doors and smoke control doors, if normally held open, to close automatically, where applicable.
- .2 Acknowledging alarm: indicated at Fire Alarm panel.
- .3 Audible signal devices shall continue to sound during the alarm conditions until manually silenced.
- .4 Possible to silence signals by "alarm silence" switch at Fire Alarm panel, after 60 second period of operation.
- .5 Silencing of the signals shall cause the "Alarm Silenced" indicator LED to light. A subsequent alarm shall cause this indicator to extinguish and all audible device to sound again.
- .6 Subsequent alarm, received after previous alarm has been silenced, to re-activate signals.
- .7 Actuation of supervisory devices to:
 - .1 Cause electronic latch to lock-in supervisory state at Fire Alarm panel.
 - .2 Indicate respective supervisory zone at Fire Alarm panel and the remote annunciator panel(s) using zone LED's and/or on the alpha numeric display.
 - .3 Cause audible signal at central control unit and remote annunciator panel(s) to sound.
 - .4 Activate common supervisory sequence.
 - .5 Activate the common trouble contact and transmit trouble signal to the approved monitoring agency.
- .8 Resetting alarm device not to return system indications/functions back to normal until control unit has been reset.
- .9 Trouble on system to:
 - .1 Indicate circuit in trouble at central control unit and at remote annunciator panel(s).
 - .2 Activate "system trouble" indication, buzzer and common trouble sequence.
Acknowledging trouble condition to silence audible indication; whereas visual indication to remain until trouble is cleared and system is back to normal.
 - .3 The following conditions shall be monitored:
 - .1 Open circuit fault in the field wiring of an addressable loop, addressable detection or signal module, or a short on an addressable loop or signal circuit
 - .2 Failure of a supervised indicator on the remote annunciator or open or short on the wiring to the annunciator
 - .3 Disconnection or failure of the battery pack
 - .4 A ground fault condition on a field wire
 - .5 Failure of the main 120VAC power supplied to the panel
 - .6 Removal or malfunction of any addressable field device or any required panel module or component.
- .10 Trouble on system: suppressed during course of alarm.

- .11 Trouble condition on any circuit in system not to initiate alarm conditions.
- .12 Transmit trouble signal to the approved monitoring agency. The owner is responsible for hiring the monitoring agency. This contractor shall provide all required equipment and connections for monitoring of the system.
- .13 Control Switches
 - .1 Reset Switch shall clear the panel of alarm or supervisory conditions once the field device is restored. Also shall perform lamp test function.
 - .2 Signal Silence shall silence the audible signals during the alarm. Switch shall be inhibited for one (1) minute from start of the alarm.
 - .3 Acknowledge Switch shall silence panel alarm and remote buzzer on annunciator.
 - .4 Fire Drill Switch allows for testing of Fire Alarm.
 - .5 Lamp Test Switch shall perform lamp test function of all indicator LEDs automatically on panel.
- .14 Additional System Parameters
 - .1 The system shall be completely field programmable through the use of a laptop computer connected temporarily for this purpose. Programming shall create a project specific file that may be copied to disk and kept for permanent record.
 - .2 Access to the system shall be password protected to 3 levels. Program fields (Example: Device Bypass, Set Time / Date, etc.) must be user selectable to any Command access level.
 - .3 The system shall contain four queues for Alarm, Supervisory, trouble and monitoring with LED indicators and selector keys
 - .4 The system shall contain a two history log of events; one for alarm related events and one for all other events. The authorized operator may view at any time. The "Previous Event" and "Next Event" controls on the panel shall be used to view the events currently showing on the panel LCD display.
 - .5 The addressable communication and signal circuits must be configurable for either Class A (DCLA or DCLC circuits as referenced in ULC S524) or Class B wiring.
 - .6 Panel to have two spare configurable keys and LED indicators for use to be determined at time of installation

2.3 SUPERVISION

- .1 The alarm activation of any device shall not prevent the subsequent alarm operation of any other device.
- .2 Provide independently supervised and independently fused indicating appliance circuits for alarm bells and strobes. Quantity as shown on the drawings.
- .3 All auxiliary manual controls shall be supervised so that all switches must be returned to the normal automatic position to clear system trouble.
- .4 Each independently supervised circuit shall include a discrete LCD "Trouble" message to indicate type of problem condition per circuit.
- .5 The incoming power to the system shall be supervised so that any power failure shall be audibly and visually indicated at the control panel. A green "Power On" LED shall be displayed continuously while incoming power is present.

- .6 The system batteries shall be supervised so that disconnection of a battery shall be audibly and visually indicated at the control panel. A "Depleted Battery" message shall indicate when standby operation has exceeded battery capacity.
- .7 The System Expansion Modules connected by ribbon cables shall be supervised for module placement. Should a module become disconnected from the C.P.U. the system trouble indicator shall illuminate and audible trouble signal shall sound.

2.4 CONTROL PANEL

- .1 Central control unit (CCU).
 - .1 Suitable for DCLA communication style: to CAN/ULC-S524.
 - .2 The CCU is to monitor and control the entire system and allow control of all system components connected to the system. The CCU shall be of modular design and shall contain the Central Processing Unit (CPU) with the operating software and non-volatile programmed memory. The CPU shall be used to process all system information.
 - .3 The CCU shall be complete with a four (4) line by twenty 20 character LCD alphanumeric display and keypad. All components shall be fully operational while the system is operating on the standby batteries. Keypad shall be membrane style. LCD display shall be back-lit for high contrast visual clarity. In normal (non-alarm) mode, the display shall show the time, date, system condition and user definable message.
 - .4 Individual zone LED's for each alarm initiating and trouble indicating (supervisory) zone plus a minimum of 25% spare capacity for future zones.
 - .5 All events are to be logged automatically in the system for future review. Charge-of-status, alarm and fault messages along with the time of day and date shall be logged. This is accomplished through using an internal memory log.
 - .6 The CPU electronics shall be microprocessor-based. All system functionally and job specific data shall be stored in non-volatile memory and shall survive a complete power failure intact. All operating software shall be executed from random access memory (RAM) to allow password protected field editing. The CPU shall have the capacity to monitor the number of addressable points required for this project plus 25% spare capacity.
 - .7 System shall contain the quantity of audible/visual signal circuits as indicated on the drawings with option for additional signal circuits. Each signal device circuit shall not be loaded to more than 80% capacity.
 - .8 The CPU must incorporate circuitry to continuously monitor the communications and data processing cycles of the microprocessor. On CPU failure, an audible and visual trouble signal shall initiate and provide a remote trouble monitoring station.
 - .9 The CPU shall be equipped with software routines to provide event initiated program (EIP) whereby the receipt of an alarm or supervisory trouble condition may be programmed to operate any or all of the system's control points. EIP actions for life safety functions shall be retained in the non-volatile PROM memory for reliability. The CPU shall also be capable of reprogramming these EIP functions in the field and retaining the changes in the RAM memory until a new set of PROM are programmed.
 - .10 The control unit shall have a minimum of one (1) analog loop base, connected in a Class A Style configuration. The CCU shall be able to process and evaluate incoming signals from addressable devices such as automatic detectors, manual pull station, supervisory valves, etc. Each loop shall be capable of communicating with up to 99 addressable sensor devices and 99 monitor output devices (198 points per loop).

- .11 The CCU shall be capable of supporting up to sixteen (16) conventional hardwired adder modules (any combination of signal, detection or relay modules) and/or four (4) analog loops.
- .12 Adder (expansion) modules may include:
 - .1 Single Loop modules identical in performance to the module integral to the CCU.
 - .2 Dual Loop modules with two (2) analog Loops identical in performance to the module integral to the CCU.
 - .3 Hardwired Loop controller module allowing sixteen (16) additional conventional hard wired adder modules to be supported.
 - .4 Adder Hardwired Modules may include
 - .1 Eight (8) Class B or four (4) Class A initiating circuits
 - .2 Four (4) signaling (indicating) circuits.
 - .3 Eight (8) relay circuits
- .13 Each addressable line module is to have its own microprocessor based circuit, working independently from the central processor board located in the control unit and operating independently from each other.
- .14 All addressable circuits shall be monitored against open circuits, ground faults and shorts. Any malfunctions in any circuit will result in an indication of a trouble condition of this address location at the Control Panel while all other addresses continue operating normally.
- .15 Should a detection device respond with either an alarm or trouble condition, its location must be displayed along with its user text of the alpha numeric display. For maintenance purposes, the panel shall have the ability to display the address information of the device in alarm/trouble condition.
- .16 Auxiliary relays shall be plug-in type with dust cover and supervised against unauthorized removal using a common trouble circuit. Shall come complete with individual bypass switch.
 - .1 Contacts: 3.0 A, 120 VAC, for functions such as release of door holders or initiation of fan shut down.
 - .2 Contact terminal size capable of accepting 22-12 AWG wire.
- .17 The system shall be capable of logging and storing 120 events in an alarm log and 120 events in a trouble log. These events shall be stored in a battery protected random access memory. Each recorded event shall include the time and data of that event's occurrence.
- .18 Provide a general evacuation switch in the control panel to provide the fire department the option of causing a general alarm.
- .19 Transmit alarm, trouble and indicate zone of alarm to monitoring agency.
- .20 CCU shall have visual indicators for the following common control functions:
 - .1 AC Power
 - .2 Alarm
 - .3 Supervisory
 - .4 Monitor
 - .5 Trouble
 - .6 Disable
 - .7 Ground Fault.
- .21 CCU shall have common control keys/buttons and visual indicators for:
 - .1 Reset

- .2 Alarm
- .3 Signal Silence
- .4 Trouble Silence
- .5 Fire Drill
- .6 Two (2) custom programmable key/button and visual indicators.
- .22 Cabinet shall be designed for the installation of the CCU, power supplies, batteries, all input and output modules, relay modules and required adder (expansion) modules.
- .23 Cabinet shall be constructed of minimum 16 Gauge cold rolled steel with powdercoat finish. Provide trim ring for recess (flush) mounting.
- .24 Cabinet shall have a universal CAT-30 lock and key assembly and a removable door.
- .25 The equipment and devices to be provided shall be compatible with the existing Siemens system on the base (Conventional Seimens TXL-1000).

2.5 POWER SUPPLIES

- .1 120 V, 60 Hz emergency power as primary source of power system. Power provided by dedicated circuit.
- .2 Voltage regulated, current limited distributed system power.
- .3 Primary power failure or power loss (less than 102 V) will activate common trouble sequence.
- .4 Interface with battery charger and battery to provide uninterruptible transfer of power to standby source during primary power failure or loss.
- .5 During normal operating conditions, a fault in the battery charging circuit, a short or open in battery leads shall activate the common trouble sequence and the standby power trouble indicator.
- .6 Standby batteries shall be sealed, gel cell type, maintenance free with minimum expected life of 10 years. The system shall be provided with sufficient battery capacity to operate the entire system upon loss of normal 120 VAC power in a full load mode for a period of twenty-four (24) hours with at least thirty (30) minutes of alarm indication at the end of this period. The system shall automatically transfer to the standby batteries upon power failure. All battery charging and recharging operations shall be automatic. Batteries, once discharged, shall recharge at a rate to provide a minimum of 70% capacity in 12 hours.
- .7 All circuits requiring system operating power shall be 24 VDC and shall be individually fused at the control panel.
- .8 Continuous supervision of wiring for external initiating and alarm circuits to be maintained during power failure.

2.6 INITIATING / INPUT CIRCUITS

- .1 Receiving circuits for alarm initiating devices such as manual pull stations, smoke detectors, heat detectors and water flow switches, wired in DCLA configuration (or other existing configuration, if different) to Fire Alarm Panel.
- .2 Loss of one zone will not affect the full operation of all remaining zones. Line isolation modules shall be provided for all zones not on a dedicated loop.
- .3 Alarm receiving circuits (active and spare) shall be compatible with smoke detectors and open contact devices.
- .4 Actuation of alarm initiating device shall cause the system to operate as specified in "System Operation".

- .5 Receiving circuits for supervisory, N/O devices. Devices shall be wired in DCLA configuration to Fire Alarm panel.
- .6 Actuation of supervisory initiating device shall cause the system to operate as specified in "System Operation".

2.7 ALARM OUTPUT CIRCUITS

- .1 Alarm output circuit: connected to signals, wired in Class A configuration.
 - .1 Signal circuits' operation to follow system programming; capable of sounding bells with temporal pattern and of operating strobes. Each signal circuit: rated at 2 A, 24 VDC, fuse protected from overloading/overcurrent.
 - .2 The central control unit shall be capable of coding main panel node notification circuits in Temporal pattern.
 - .3 The central control unit shall synchronize specific strobe lights designed to accept a specific "synchronization pulse."
 - .4 Manual alarm silence, automatic alarm silence and alarm silence inhibit to be provided by system's common control.

2.8 AUXILIARY CIRCUITS

- .1 Auxiliary contacts shall be provided for control functions.
- .2 Actual status indication (positive feedback) from controlled device
- .3 Alarm or supervisory trouble on the system shall cause the operation of programmed auxiliary output circuits.
- .4 Upon resetting the system, auxiliary contacts shall return to normal or shall operate as pre-programmed.
- .5 Fans shall be stagger-started upon system reset. Provide a timing circuit to separately start each fan or set of fans connected to auxiliary contact on system. Timing circuit shall be controlled by Fire Alarm panel.
- .6 Auxiliary circuits: rated at 2 A, 24 V DC or 120 V AC, fuse-protected.

2.9 WIRING

- .1 Solid tinned copper, annealed conductors with coded PVC insulation, and with overall red PVC jacket. Cables shall be CSA Certified, ULC Listed, 300 Volt, 105°C.
- .2 To initiating circuits: 18 AWG minimum, and in accordance with manufacturer's requirements.
- .3 To signal circuits: 14 AWG minimum and in accordance with manufacturer's requirements.
- .4 To control circuits: 14 AWG minimum, and in accordance with manufacturer's requirements.
- .5 Provide for resistance in wire of not more than 50 ohms for audible signal circuits, 12 AWG minimum.
- .6 The Voltage drop on ANY signal circuit shall not exceed 10%.
- .7 Risers and trunk connections: Mineral Insulated Copper-Clad (MICC), shielded twisted pairs, 2-hour fire-rated, configured to eliminate interference and cross-talk.
- .8 All wiring between buildings shall also be 2-hour fire-rated MICC cables.
- .9 All analog Loop wiring shall be via unshielded twisted pair with maximum of 40 ohms loop resistance and maximum 0.5 microfarad capacitance.

2.10 AUTOMATIC ALARM INITIATING DEVICES

- .1 Setting an alarm initiating device shall be by a physical means. Use of rotary dial switches or dual in-line pin (DIP) switches are acceptable. Devices that use electronic addressing or require the use of special programmers will not be accepted
- .2 Addressable heat detectors: fixed temperature type shall be rated 135°F, 57°C.
- .3 Addressable thermal fire detectors: combination fixed temperature and rate of rise type. Non-restorable fixed temperature elements. Self-restoring rate of rise. Fixed temperature shall be 57°C. Rate of rise shall be 8.3°C per minute using a dual thermistor circuit.
- .4 Addressable duct smoke detector shall be photoelectric type with sampling tubes and protective housing. Lengths of sampling tubes as required.
 - .1 Plug-in type detector with fixed base.
 - .2 Complete with remote LED indicating light mounted on underside of adjacent ceiling or as directed by the DCC Representative.
 - .3 Detector address to be set on detector base in field.
- .5 Addressable smoke detector: Photoelectric type, plug-in type with fixed base. Wire-in base assembly shall have integral continuously lit red LED when in alarm mode. The smoke detector shall be capable of communicating its status (i.e. alarm, "dirty sensor") and to adjust its parameters from the CCU.
- .6 Addressable point modules for use with normally open conventional initiating devices that are required to be addressable. Each Module shall provide one address and shall be connected to an addressable loop of the fire alarm system for monitoring. Module address to be set on the unit in the field.

2.11 MANUAL ALARM INITIATING (PULL) DEVICES

- .1 Addressable manual alarm pull station shall be break glass type on wall mounted or recessed outlet box. Non-coded single pole with normally open contact for single stage operation. Addressable type. Maximum pull force required to operate of 22.2 N.
- .2 Enclosure shall be aluminum with red powdercoat finish.
- .3 Address of pull stations to be set on the back of the back of the device.

2.12 AUDIBLE/VISUAL ALARM SYSTEM DEVICES

- .1 Provide bells and strobes as indicated on drawings.
- .2 10" Bells shall be minimum 90dB at 3 metres while 6" Bells shall be minimum 86dB at 3 metres, surface mounted, red colour, 24 VDC with temporal pattern signal.
- .3 Strobes shall be solid state, flashing, red, 24 VDC, with word "FIRE" inscribed on polycarbonate lens.
- .4 Solid state circulating with Zenon tube to produce 8000 peak candlepower at one flash per second with field selectable candela settings from 15 to 185 cd. Provide candela settings as indicated on drawings.
- .5 Designed for surface mounting on ceiling or walls as indicated.
- .6 Provide wire guards where indicated.
- .7 Strobes shall be synchronized.
- .8 Bells and strobes shall be installed on a separate notification appliance circuits.

- .9 Bell and strobes shown as combo symbols on drawings shall be installed as separate devices on common bell/strobe backplate.

2.13 GRAPHIC ANNUNCIATOR

- .1 Graphic annunciator shall have minimum dimensions of 900 mm x 900 mm.
- .2 Graphic annunciator to be passive type, located at building entrance, behind plexiglass, hinged, completed with lockable front.
- .3 Graphic to include building outline, floor plan, stairs, entrances, exits, "You Are Here", north arrow and fire alarm zones.

2.14 'AS BUILT' RISER DIAGRAM

- .1 Fire alarm system riser diagram shall be mounted in a glazed frame on black lamicoid sheet with beveled edges, white lettering and designations, minimum size 600 x 600 mm. Riser shall be mounted beside the Fire Alarm Control Panel.

2.15 ANCILLARY DEVICES

- .1 Remote relay unit to initiate fan shutdown, where applicable.

2.16 FAULT ISOLATION MODULE

- .1 On the addressable loop, the fault isolation module shall provide isolation of short-circuited sections of the addressable loop, preventing the entire loop from becoming inoperable and allowing addressable devices and modules in the non-shortened sections to continue to function properly.

2.17 END OF LINE DEVICES

- .1 End of Line Devices shall be sized as per the manufacturer's recommendations. Mount devices within outlet boxes separate from those for other devices at the locations indicated, and install less than 1800 mm above finished floor level, measured from the centre of the end-of-line device, and located beyond the last device in the circuit or terminated in a control unit or transponder. Fire alarm and detection system components shall be accessible for purposes of inspection or maintenance. Provide on the coverplate for each such device an approved nameplate, engraved "END-OF-LINE DEVICE" or with an approved symbol. Provide red lamacoid plate with white 6mm letters identifying zone.

2.18 ACCEPTABLE MANUFACTURER

- .1 The equipment and devices to be provided shall be compatible with the existing Siemens system on the base (Conventional Seimens TXL-1000).

Part 3 Execution

3.1 INSTALLATION SCHEDULE

- .1 System must be complete, approved and operational before the project completion date or the contractor will be held accountable for costs associated with late opening.
- .2 Do not commence any item of work affecting any part of an existing system until all necessary materials are on site for that item of work. Having started such an item, carry out work continuously until that portion of the system is restored to full operation.

3.2 INSTALLATION

- .1 Install systems in accordance with CAN/ULC-S524.
- .2 Install all components per manufacturer's recommendations, and co-ordinate with the installation schedule.
- .3 Where required, install fire alarm remote annunciator panel(s) so that the alphanumeric displays are between 1500 mm and 1700 mm AFF.
- .4 Install manual alarm pull stations and connect to alarm circuit wiring.
- .5 Locate and install detectors and connect to alarm circuit wiring. Do not mount detectors within 1 m of air outlets. Maintain at least 600 mm radius clear space on ceiling, below and around detectors. Local duct type detectors in straight portions of ducts
- .6 Connect alarm circuits to main control panel.
- .7 Install bells and visual signal devices and connect to signaling circuits.
- .8 Connect signaling circuits to main control panel.
- .9 Install remote annunciator panels and connect to annunciator circuit wiring, where applicable.
- .10 Install door-releasing devices, where applicable.
- .11 Install remote relay units to control fan shut down, where applicable.
- .12 Sprinkler system. Provide addressable point modules and connect alarm and supervisory switches. Connect circuit(s) to control panel.
- .13 Splices are not permitted.
- .14 Provide all necessary raceways, cable and wiring to make interconnections to terminal boxes, annunciator equipment and FACP, as required by equipment manufacturer.
- .15 Provide outlet boxes of ample size for clearance to wiring connections. Provide recessed boxes for manual pull stations complete with plaster rings.
- .16 Knock-out type back boxes will NOT be permitted.
- .17 Ensure that wiring is free of opens, shorts or grounds, before system testing and hand-over.
- .18 Identify circuits and other related wiring at central control unit, annunciators and terminal boxes.

3.3 WIRING INSTALLATION

- .1 Provide all necessary interconnections and remote signal wiring, in accordance with these specifications, the tender drawings, the manufacturer's wiring diagrams, the requirements of the Ontario Electrical Safety Code and the Inspection Authority.
- .2 Provide terminal cabinets complete with terminal blocks for wiring convenience at junction points in the system where recommended by the manufacturer.
- .3 All conductors shall be cut at each station, detector and signaling device and connections shall be made in the approved manner to ensure proper supervision of the wiring. This will require the use of four (4) screws at each device.

3.4 TESTING AND INSPECTION

- .1 The manufacturer's representative shall make an inspection of the fire alarm equipment, including those components necessary to the direct operation of the system such as manual pull stations, thermal and smoke-actuated detectors and controls, whether or not the equipment was

made by the fire alarm system manufacturer. The inspection shall comprise an examination and test of the equipment for the following:

- .1 That the type of equipment installed is that designated by the specifications.
- .2 That the wiring connections to all equipment components were done in accordance with all ULC, CSA and Ontario Electrical Safety Code requirements.
- .3 That all products-of-combustion (smoke) detectors have been properly calibrated and adjustments set correctly.
- .4 That equipment made by the fire alarm system manufacturer have been installed in accordance with the manufacturer's recommendations and that all alarm-initiating, annunciation and signaling devices of any manufacture have been operated or tested to verify their operation.
- .5 That supervisory wiring of those items of equipment connected to a supervised circuit are operating and that the wiring meets the requirements of the inspecting authorities.
- .6 Testing to be done in the presence of and to the satisfaction of the local building inspector and the authorities having jurisdiction.
- .7 Fire alarm system shall be verified as per CAN/ULC S537.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 03 30 00 – Cast-in-place Concrete.
- .2 Section 31 23 33.01 - Excavating, Trenching and Backfilling
- .3 Section 32 11 16.01 – Granular Sub-base
- .4 Section 32 11 23 – Aggregate Base Courses
- .5 Section 33 14 16 – Site Water Utility Distribution Piping
- .6 Section 33 31 11 – Public Sanitary Sewage Gravity Piping
- .7 Section 33 65 76 - Direct Buried Underground Cable Duct.

1.2 REFERENCE STANDARDS

- .1 ASTM International (ASTM)
 - .1 ASTM D4791-19, Standard Test Method for Flat Particles, Elongated Particles, or Flat and Elongated Particles in Coarse Aggregate.
- .2 Ontario Provincial Standard Specification:
 - .1 OPSS Muni 1004 Material Specification For Aggregates - Miscellaneous
 - .2 OPSS Muni 1010 Aggregates - Base, Subbase Select Subgrade, and Backfill Material.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 – Submittal Procedures.
- .2 Provide quality control test results to DCC Representative for review.
- .3 Provide DCC Representative with access to source and processed material for sampling.
- .4 Allow continual sampling by DCC Representative during production.

1.4 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements.
- .2 Transportation and Handling: handle and transport aggregates to avoid segregation, contamination and degradation.

Part 2 Products

2.1 MATERIALS

- .1 Contractor to follow all testing requirements and provide documentation for all imported fill material.
- .2 Aggregate quality: sound, hard, durable material free from soft, thin, elongated or laminated particles, organic material, clay lumps or minerals, free from adherent coatings and injurious amounts of disintegrated pieces or other deleterious substances.
- .3 Flat and elongated particles of coarse aggregate: to [ASTM D 4791](#).
 - .1 Greatest dimension to exceed 5 times least dimension.
- .4 Fine aggregates satisfying requirements of applicable section to be one, or blend of following:
 - .1 Natural Sand.
 - .2 Manufactured sand.
- .5 Coarse aggregates satisfying requirements of applicable section to be one of or blend of following:
 - .1 Crushed rock.
 - .2 Gravel and crushed gravel composed of naturally formed particles of stone.
 - .3 Light weight aggregate.
- .6 Clear stone:
 - .1 19mm Type I clear stone in accordance with OPSS Muni 1004, Table 1 and Table 2.
- .7 Mortar, Masonry, Bedding Sand: direct bury cables/duct bedding and ductbank cover
 - .1 Mortar sand in accordance with OPSS Muni 1004, meeting physical properties and gradation requirements shown in Table 5 and Table 6 respectively
- .8 Granulars:
 - .1 Granular A in accordance with OPSS Muni 1010.
 - .2 Granular B Type I in accordance with OPSS Muni 1010.

2.2 SOURCE QUALITY CONTROL

- .1 Inform DCC Representative of proposed source of aggregates and provide access for sampling 4 weeks minimum before starting production.
- .2 If materials from proposed source do not meet, or cannot reasonably be processed to meet, specified requirements, locate alternative source.
- .3 Advise DCC Representative 4 weeks minimum in advance of proposed change of material source.
- .4 If aggregates are from multiple sources, testing is required from each source.
- .5 Acceptance of material at source does not preclude future rejection if it fails to conform to requirements specified, lacks uniformity, or if its field performance is found to be unsatisfactory.

- .6 The Contractor shall be responsible for quality control (QC) sampling and testing required to show conformance of the aggregates. The Contractor shall be responsible for all costs associated with QC sampling and testing.
- .7 Aggregates testing and frequency:
 - .1 Gradation analysis – 1 test for each 1,000 tonnes of placement
 - .2 Physical property analysis – 1 test for each 5,000 tonnes of placement
 - .3 Standard Moisture Density relationship (proctor) – 1 test for each 5,000 tonnes of placement
- .8 Contractor to submit QC testing results to DCC Representative as per PART 1.3 ACTION AND INFORMATIONAL SUBMITTALS.
- .9 Quality assurance inspection or testing by the DCC Representative will not augment or replace Contractor quality control nor relieve Contractor of his contractual responsibility.

Part 3 Execution

3.1 STOCKPILING

- .1 Stockpile aggregates on site in pre-approved location. Do not stockpile on completed pavement surfaces.
 - .1 Contractor to identify stockpiling location(s) in writing to the DCC Representative for approval a minimum of 5 days prior to stockpiling material.
- .2 Stockpile aggregates in sufficient quantities to meet project schedules.
- .3 Stockpiling sites to be level, well drained, and of adequate bearing capacity and stability to support stockpiled materials and handling equipment.
- .4 Separate different aggregates by strong, full depth bulkheads, or stockpile far enough apart to prevent intermixing.
- .5 Do not use intermixed or contaminated materials. Remove and dispose of rejected materials as directed by DCC Representative within 48 hours of rejection.
- .6 During winter operations, prevent ice and snow from becoming mixed into stockpile or in material being removed from stockpile.
- .7 Protect stockpiled materials from weather elements as necessary.

3.2 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.
 - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.
- .3 Leave aggregate stockpile site in tidy, well drained condition, free of standing surface water.

- .4 Leave any unused aggregates in neat compact stockpiles as directed by DCC Representative.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 31 05 16 - Aggregates for Earthwork
- .2 Section 31 23 33.01 - Excavating, Trenching and Backfilling

1.2 DEFINITIONS

- .1 Rock: Solid material in excess of 0.25 m³. Frozen material not classified as rock.
- .2 Peak Particle Velocity (PPV): Maximum speed or velocity reached by a particle in a medium, such as the ground, as a result of a seismic or vibrational event. It is used to quantify the intensity of ground motion caused by various sources, including earthquakes, explosions, construction activities, or industrial processes. PPV is measured in mm/s.

1.3 ADMINISTRATIVE REQUIREMENTS

- .1 Regulatory Requirements:
 - .1 Comply with authority having jurisdiction (AHJ) requirements.
- .2 Coordination:
 - .1 Coordinate with Section 01 57 00 - Temporary Controls for erosion and sediment control measures.

Part 2 Products

2.1 NOT USED

- .1 Not used.

Part 3 Execution

3.1 PREPARATION

- .1 Protection of In-Place Conditions:
 - .1 Vibration Control:
 - .1 Limit ground vibrations to avoid damage to structures or remaining rock mass.

3.2 ROCK REMOVAL - GENERAL

- .1 Remove rock to alignments, profiles, and cross sections indicated on Drawings.
- .2 Excavate rock to produce uniform and stable excavation surfaces.

- .3 Excavate rock to form level bearing that follows natural strata. Form with sharp steps.
- .4 Prepare rock surfaces to be bond to concrete, by scaling, pressure- washing, and broom cleaning surfaces.
- .5 Excavate trenches to lines, widths, and grades to minimum of 600mm below pipe inverts. Provide recesses for bell and spigot pipes to ensure bearing will occur uniformly along barrel of pipe.
- .6 Remove boulders and fragments which may slide or roll into excavated areas.
- .7 Minimize overbreak and avoid damage to adjacent structures.
- .8 Correct unauthorized rock removal in accordance with Section 31 23 33.01 - Excavating, Trenching and Backfilling at no extra cost.

3.3 ROCK REMOVAL - MECHANICAL

- .1 Excavate rock using mechanical methods.
- .2 Remove final layers carefully to provide sound and unshattered base for footings and foundations.
- .3 Bedrock removal at this site could be carried out using hoe ramming techniques in conjunction with line drilling on close centres. Provided that good bedrock excavation techniques are used, the bedrock could be excavated using near vertical side walls. Any loose bedrock should be scaled from the sides of the excavation for worker safety.

3.4 CLEANING

- .1 Waste Management:
 - .1 Manage waste in accordance with Section 01 74 19 - Waste Management and Disposal and:
 - .1 Rock Disposal:
 - .1 Dispose of removed rock off site.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 02 41 13 - Selective Site Demolition
- .2 Section 02 41 13.13 - Paving Removal
- .3 Section 26 05 00 - Common Work Results - Electrical.
- .4 Section 26 05 43.01 - Installation of Cables in Trenches and Ducts
- .5 Section 31 05 16 - Aggregates for Earthwork.
- .6 Section 32 91 19.13 - Topsoil Placement and Grading
- .7 Section 33 14 16 - Site Water Utility Distribution Piping
- .8 Section 33 31 11 - Public Sanitary Sewage Gravity Piping
- .9 Section 33 65 73 - Concrete Encased Ductbanks and Manholes
- .10 Section 33 65 76 - Direct Buried Underground Cable Duct.

1.2 REFERENCE STANDARDS

- .1 ASTM International (ASTM)
 - .1 ASTM C136-19, Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates.
 - .2 ASTM D698-12 (2021), Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft³) (600 kN-m/m³).
 - .3 ASTM D1557-12 (2021), Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft³) (2,700 kN-m/m³).
 - .4 ASTM D4318-17e1, Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils.
- .2 Canadian General Standards Board (CGSB)
 - .1 CAN/CGSB-8.2-M88, Sieves, Testing, Woven Wire, Metric.
- .3 CSA Group (CSA)
 - .1 CAN/CSA-A3000-03, Cementitious Materials Compendium (Consists of A3001, A3002, A3003, A3004 and A3005).
 - .1 CSA-A3001-03, Cementitious Materials for Use in Concrete.
 - .2 CSA-A23.1-04/CAN/A23.2-04, Concrete Materials and Methods of Concrete Construction/Methods of Test and Standard Practices for Concrete.
- .4 Environmental Protection Act, R.S.O. 1990, c. E.19
 - .1 O. Reg. 406/19: On-Site and Excess Soil Management

- .2 O. Reg. 153/04: Records of Site Condition - Part XV.1 of the Act
- .5 Occupational Health and Safety Act
 - .1 Occupational Health and Safety Act, R.S.O. 1990, c. O.1
 - .2 Ontario Regulation 213/91 Construction Projects
- .6 Ontario Provincial Standard Specification (OPSS).
 - .1 OPSS Muni 1004 Material Specification For Aggregates-Miscellaneous
 - .2 OPSS MUNI 1010 Aggregates - Base, Subbase Select Subgrade, and Backfill Material.

1.3 DEFINITIONS

- .1 Unclassified excavation: excavation of deposits of whatever character encountered in Work.
- .2 Waste material: excavated material unsuitable for use in Work or surplus to requirements.
- .3 Borrow material: material obtained from locations outside area to be graded, and required for construction of fill areas or for other portions of Work.
- .4 Excess Soil - Soil that has been excavated, typically during construction activities, that must be moved off-site because it can't or won't be reused at the project site.
- .5 Recycled fill material: material, considered inert, obtained from alternate sources and engineered to meet requirements of fill areas.
- .6 Unsuitable materials:
 - .1 Weak, chemically unstable, and compressible materials.
 - .2 Frost susceptible materials:
 - .1 Fine grained soils with plasticity index less than 10 when tested to ASTM D4318, and gradation within limits specified when tested to ASTM D422 and ASTM C136: Sieve sizes to CAN/CGSB-8.2.
 - .2 Coarse grained soils containing more than 20% by mass passing 0.075 mm sieve.
- .7 Unshrinkable fill: very weak mixture of cement, concrete aggregates and water that resists settlement when placed in utility trenches, and capable of being readily excavated.
 - .1 The unshrinkable backfill shall contain 25 kg/m³ of Type GU Portland cement according to CAN/CSA A3001 and may contain additional supplementary cementing materials.
 - .2 The material shall be designed so that it can flow into the excavation and fill the entire space without vibration and segregation.
 - .3 The 28-Day compressive strength shall be a maximum of 0.40 MPa

1.4 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Make submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Submit for review by DCC Representative erosion and sediment control plan and proposed dewatering and heave prevention methods as described in PART 3 of this Section.
- .3 Contractor to request and receive Ontario One Call locates prior to commencing any excavation works.

- .4 Contractor to initiate DND Dig Permit through the DCC Representative a minimum of 20 business days prior to commencing excavation works. Contractor not to commence excavation works until Dig Permit is received.
- .5 Contractor to provide Waste Management and Disposal Plan.
- .6 Submit to DCC Representative inspection and testing results and reports as described in PART 3 of this Section.
- .7 Preconstruction Submittals:
 - .1 Submit construction equipment list for major equipment to be used in this section prior to start of Work.
 - .2 Submit records of underground utility locates, indicating: location plan of existing utilities as found in field, clearance record from utility authority, location plan of relocated and abandoned services, as required.
- .8 Samples:
 - .1 Submit samples in accordance with Section 01 33 00 - Submittal Procedures.
 - .2 Inform DCC Representative at least 4 weeks prior to beginning Work, of proposed source of fill materials and provide access for sampling.
- .9 Engage services of qualified professional Engineer who is registered or licensed in Ontario, Canada in which Work is to be carried out to design and inspect cofferdams, shoring, bracing and underpinning required for Work.

1.5 WASTE MANAGEMENT AND DISPOSAL

- .1 Dispose of surplus excavated material in accordance with Section 02 41 13 - Selective Site Demolition and Section 01 74 19 - Waste Management and Disposal.

1.6 EXISTING CONDITIONS

- .1 Buried services:
 - .1 Before commencing work, verify the location of buried services on and adjacent to site.
 - .2 Size, depth and location of existing utilities and structures as indicated are for guidance only. Completeness and accuracy are not guaranteed.
 - .3 Prior to beginning excavation Work, notify applicable authorities having jurisdiction to establish location and state of use of buried utilities and structures. Have the applicable authorities clearly mark such locations to prevent disturbance during Work.
 - .4 Arrange with appropriate authority for relocation of buried services that interfere with execution of work.
 - .5 Confirm locations of buried utilities by careful test excavations or soil hydrovac methods.
 - .6 Where utility lines or structures exist in area of excavation, obtain direction of DCC Representative before removing or re-routing. Costs for re-routing or removing existing utilities not identified in the contract documents to be paid by Owner.
 - .7 Record location of maintained, re-routed and abandoned underground lines.
 - .8 Confirm locations of recent excavations adjacent to area of excavation.
- .2 Existing buildings and surface features:

- .1 Conduct, with the DCC Representative, condition survey of existing buildings, trees and other plants, lawns, fencing, service poles, wires, rail tracks, pavement, survey bench marks and monuments which may be affected by Work.
- .2 Protect existing buildings and surface features from damage while Work is in progress. In event of damage, immediately make repair as directed by the DCC Representative, at no cost to DCC or the Owner.
- .3 Where required for excavation, cut roots or branches as directed by the DCC Representative.

Part 2 Products

2.1 MATERIALS

- .1 Contractor to follow all testing requirements and provide documentation.
- .2 Type 1 fill: sub-bedding trench material (if required); bedding and cover for watermain; backfill for concrete encased duct banks; roadway granular base material; gravel access
 - .1 Granular A in accordance with OPSS MUNI 1010.
- .3 Type 2 fill: roadway granular sub-base material
 - .1 Granular B Type I in accordance with OPSS MUNI 1010, or
- .4 Type 3 fill: backfill for trenches
 - .1 Selected material from excavation or other sources, approved by DCC Representative for use intended, unfrozen and free from rocks larger than 75 mm, cinders, ashes, sods, refuse or other deleterious materials.
 - .1 Sampling and testing of Type 3 fill.
- .5 Mortar, Masonry, Bedding Sand: direct bury cables/duct bedding and ductbank cover
 - .1 Mortar sand in accordance with OPSS Muni 1004, meeting physical properties and gradation requirements shown in Table 5 and Table 6 respectively
- .6 Granular Material:
 - .1 Granular A in accordance with OPSS MUNI 1010.
 - .2 Granular B Type II in accordance with OPSS MUNI 1010.
- .7 Unshrinkable fill: proportioned and mixed to provide:
 - .1 Maximum compressive strength of 0.4 MPa at 28 days.
 - .2 Minimum strength of 0.07 MPa at 24 h.
 - .3 Concrete aggregates: to CSA-A23.1/A23.2.
 - .4 Cement: Type GU.
 - .5 Slump: 180mm $\pm$ 40 mm.

Part 3 Execution

3.1 TEMPORARY EROSION AND SEDIMENTATION CONTROL

- .1 Contractor shall submit a sediment and erosion control plan.
 - .1 Provide temporary erosion and sedimentation control measures to prevent soil erosion and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways.
 - .2 Inspect, repair, and maintain erosion and sedimentation control measures during construction until permanent vegetation has been established.

3.2 SITE PREPARATION

- .1 Remove obstructions, ice and snow, from surfaces to be excavated within limits indicated.
- .2 Cut pavement or sidewalk neatly along limits of proposed excavation in order that surface may break evenly and cleanly in accordance with Section 02 41 13 - Selective Site Demolition and Section 02 41 13.13 - Paving Removal.

3.3 PREPARATION/PROTECTION

- .1 Keep excavations clean, free of standing water, and loose soil.
- .2 Protect natural and man-made features required to remain undisturbed. Unless otherwise indicated or located in an area to be occupied by new construction, protect existing trees from damage.
- .3 Protect buried services that are required to remain undisturbed.

3.4 STOCKPILING

- .1 Stockpile fill materials in areas designated by DCC Representative.
 - .1 Stockpile granular materials in manner to prevent segregation.
- .2 Protect fill materials from contamination.
- .3 Implement sufficient erosion and sediment control measures to prevent sediment release off construction boundaries and into water bodies.

3.5 COFFERDAMS, SHORING, BRACING AND UNDERPINNING

- .1 Maintain sides and slopes of excavations in safe condition by appropriate methods.
- .2 Excavations should be sloped in accordance with the most stringent requirements of the Canada Occupational Health and Safety Regulations (SOR/86-304), Occupational Health and Safety Act (OHSA) and Regulations for Construction Projects (O. Reg. 213/91).
 - .1 If the required side slopes for the excavations cannot be provided due to space limitations, then excavated side slopes should be supported
 - .1 Contractor shall engage services of qualified professional Engineer who is registered or licensed in Ontario, Canada to design and inspect cofferdams, shoring, bracing and underpinning required for Work.

- .3 Trench cages or boxes may be required to prevent undermining of adjacent structures and/or underground utilities
- .4 During backfill operation:
 - .1 Unless otherwise indicated or directed by DCC Representative, remove sheeting and shoring from excavation
 - .2 Do not remove bracing until backfilling has reached respective levels of such bracing.

3.6 DEWATERING AND HEAVE PREVENTION

- .1 Keep excavations free of water while Work is in progress.
- .2 Avoid excavation below groundwater table if quick condition or heave is likely to occur.
 - .1 Prevent piping or bottom heave of excavations by groundwater lowering, sheet pile cut-offs, or other means.
- .3 Protect open excavations against flooding and damage due to surface run-off.
- .4 Dispose of water to approved runoff areas and in a manner not detrimental to public and private property, or portion of Work completed or under construction.
 - .1 Provide and maintain temporary drainage ditches and other diversions outside of excavation limits.

3.7 GROUNDWATER MANAGEMENT – UNDERGROUND WATER STORAGE TANK

- .1 The groundwater level was measured at depths ranging from about 1.2 to 2.4 metres below the existing ground surface. The subsurface conditions consist of weathered silt and clay crust over glacial till soil over limestone bedrock.
- .2 Minor ground water inflow to excavations is anticipated from the fine-grained soils. A more significant groundwater inflow will likely occur from the more coarse-grained glacial till and from fractured bedrock.
- .3 It is expected that any groundwater inflow for temporary excavations for foundations or service utility trenches can be handled from within the excavation by pumping from filtered sumps. Suitable detention and filtration will be required before discharging the water to a sewer or ditch, in addition to the necessary sewer discharge approvals.
- .4 To reduce the amount of dewatering, it is suggested that the proposed construction not be undertaken during spring conditions. Refer to Section 3.8 for commentary on groundwater permitting requirements.

3.8 GROUNDWATER PERMITTING REQUIREMENTS

- .1 The dewatering requirements for the proposed works is likely to exceed 50,000 litres per day and will require a hydrogeological investigation in support of an Environmental Activity Sector Registry (EASR), for groundwater pumping up to 400,000 litres per day, or a Category 3 Permit To Take Water (PTTW), for groundwater pumping greater than 400,000 litres per day. An EASR may be sufficient for a single open trench excavation for this project.

- .2 Groundwater dewatering volumes may be reduced through the use of temporary shoring (e.g. sheet piling or trench box), however, should there be multiple excavations open or trenchless crossings carried out simultaneously, groundwater pumping could exceed 400,000 litres per day, requiring a Category 3 Permit To Take Water.

3.9 EXCAVATION

- .1 Advise the DCC Representative at least 20 business days in advance of excavation operations to initiate and obtain approval for DND Dig Permit.
- .2 Excavate to lines, grades, elevations and dimensions as indicated.
- .3 Remove concrete, paving, walks, demolished foundations, and other obstructions encountered during excavation in accordance with Section 02 41 13 - Selective Site Demolition and Section 02 41 13.13 - Paving Removal.
- .4 Excavation must not interfere with bearing capacity of adjacent foundations.
- .5 Do not disturb soil within branch spread of trees or shrubs that are to remain.
 - .1 If excavating through roots, excavate by hand and cut roots with sharp axe or saw.
- .6 For trench excavation, unless otherwise authorized by the DCC Representative in writing, do not excavate more than 30m of trench in advance of installation operations and do not leave open more than 15m at end of day's operation.
- .7 Keep excavated and stockpiled materials safe distance away from edge of trench as directed by DCC Representative.
- .8 Cobbles and boulders should be anticipated in the glacial till and at the interface between the soils and the bedrock, which may lead to increased excavation effort and slower progress. As such, an allowance should be made for removal of boulders from the glacial till during excavation which may require use of larger excavation plant.
- .9 Restrict vehicle operations directly adjacent to open trenches.
- .10 Do not obstruct flow of surface drainage or natural watercourses.
- .11 Earth bottoms of excavations to be undisturbed soil, level, free from loose, soft or organic matter.
- .12 Notify DCC Representative when bottom of excavation is reached. Notify DCC Representative if bottom of excavation appears unstable and proceed as directed by DCC Representative.
- .13 Obtain DCC Representative approval of completed excavation.
- .14 Remove unsuitable material from trench bottom including those that extend below required elevations to extent and depth as directed by DCC Representative.
- .15 Correct unauthorized over-excavation as follows:
 - .1 Fill under bearing surfaces and footings with Granular 'A' compacted to not less than 100% of corrected Standard Proctor maximum dry density.

- .2 Fill under other areas with Type 3 fill compacted to not less than 98% of corrected Standard Proctor maximum dry density.
- .16 Hand trim, make firm and remove loose material and debris from excavations.
 - .1 Where material at bottom of excavation is disturbed, compact foundation soil to density at least equal to undisturbed soil.
- .17 Dispose of surplus and unsuitable excavated material off site.

3.10 FILL TYPES AND COMPACTION

- .1 Use types of fill as indicated or specified below. Compaction densities are percentages of maximum densities obtained from ASTM D 698.
 - .1 Type 1 fill (Granular A): sub-bedding material for pipes/sewers (as required), bedding material & cover material for pipes/sewers
 - .1 Compact to 98% of standard proctor maximum dry density.
 - .2 Type 3 fill (select subgrade material): trench backfill
 - .1 Compact to 98% of standard proctor maximum dry density.
 - .3 Place unshrinkable fill in areas as indicated.

3.11 BEDDING AND SURROUND OF UNDERGROUND SERVICES

- .1 Place and compact granular material for bedding and surround of underground services as indicated and as specified in the following:
 - .1 Section 33 31 11 - Public Sanitary Sewerage Gravity Piping
 - .2 Section 33 65 76 - Direct Buried Underground Cable Duct.
- .2 Place bedding and surround material in unfrozen condition.

3.12 BACKFILLING

- .1 Vibratory compaction equipment: Equipment suitable to meet compaction requirements.
- .2 Do not proceed with backfilling operations until completion of following:
 - .1 DCC Representative has inspected and approved installations.
 - .2 Inspection, testing, approval, and recording location of underground utilities.
 - .3 Removal of concrete formwork.
 - .4 Removal of shoring and bracing; backfilling of voids with satisfactory soil material.
- .3 Areas to be backfilled to be free from debris, snow, ice, water and frozen ground.
- .4 Do not use backfill material which is frozen or contains ice, snow or debris.
- .5 Over 1.5m below finished grade - Place backfill material in uniform layers not exceeding 300mm compacted thickness up to grades indicated. Compact each layer before placing succeeding layer.
- .6 Within 1.5m to finished grade - Place backfill material in uniform layers not exceeding 150mm compacted thickness up to grades indicated. Compact each layer before placing succeeding layer.
- .7 Backfilling around installations:

- .1 Place bedding and surround material as specified elsewhere.
- .2 Do not backfill around or over cast-in-place concrete within 24 hours after placing of concrete.
- .3 Place layers simultaneously on both sides of installed Work to equalize loading. Difference not to exceed 300mm.
- .4 Where temporary unbalanced earth pressures are liable to develop on walls or other structures:
 - .1 Permit concrete to cure for minimum 14 days or until it has sufficient strength to withstand earth and compaction pressure and approval obtained from DCC Representative, or:
 - .2 If approved by DCC Representative, erect bracing or shoring to counteract unbalance, and leave in place until removal is approved by DCC Representative.
- .8 Place unshrinkable fill in areas where compaction cannot be achieved.

3.13 FIELD QUALITY CONTROL

- .1 The Contractor shall be responsible for all quality control inspection, laboratory testing and compaction testing.
- .2 Laboratory testing shall be performed on bedding and backfill to determine the optimum moisture content (OMC) and maximum dry density (MDD), required for compaction testing, and in accordance with Section 31 05 16 - Aggregate Materials.
- .3 All compaction testing must be carried out by a qualified technician, trained in safe operation, transportation and handling of nuclear gauge. Technician performing compaction tests to be on-site during all compaction operations.
- .4 Minimum compaction testing frequency:
 - .1 Bedding, embedment, cover, or backfill material for pipe, sewer and duct sections more than 20.0 m in length that are being placed in one operation, earth or granular:
 - .1 Every lift, 1 test per 20m maximum length.
 - .2 Bedding, embedment, cover, or backfill material for pipes, sewer and duct sections less than 20.0 m in length that are being placed in one operation or backfill to utility structures or small foundations (e.g., anchor blocks, sign posts, and formwork), earth or granular:
 - .1 Every lift, 1 test per 20m maximum length.
 - .3 Structure backfill and sewer and water bedding, embedment, cover, or backfill material, granular:
 - .1 Every lift, and every 20m of placement, minimum 2 tests per utility trench
- .5 Submit compaction test results at the completion of each day to DCC Representative for review.
- .6 Contractor shall conduct and submit satisfactory compaction test results to DCC Representative prior to placement of subsequent material. The DCC Representative will not consider payment for placement of any material unless satisfactory quality control test results are submitted by the Contractor.
- .7 All costs associated with quality control inspection and testing will be borne by the Contractor.

- .8 DCC Representative may conduct own Quality Assurance testing as deemed appropriate at own cost.
- .9 Quality assurance inspection or testing by the DCC Representative will not augment or replace Contractor quality control nor relieve Contractor of his contractual responsibility.

3.14 RESTORATION

- .1 Upon completion of Work, remove waste materials and debris, trim slopes, and correct defects as directed by DCC Representative.
- .2 Imported topsoil and sod as indicated on the drawings.
- .3 Reinstate lawns to elevation which existed before excavation.
- .4 Reinstate pavements, sidewalks and concrete steps disturbed by excavation to thickness, structure and elevation which existed before excavation in all areas.
- .5 Clean and reinstate areas affected by Work as directed by the DCC Representative.
- .6 Protect newly graded areas from traffic and erosion and maintain free of trash or debris.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 31 05 16 - Aggregate Materials.
- .2 Section 31 23 33.01 - Excavating, Trenching and Backfilling.
- .3 Section 32 11 23 - Aggregate Base Courses.

1.2 REFERENCE STANDARDS

- .1 ASTM International
 - .1 ASTM C136/C136M-19, Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates.
 - .2 ASTM D6913/D6913M-17, Standard Test Method for Particle-Size Distribution (Gradation) of Soils Using Sleeve Analysis.
 - .3 ASTM D698-12 (2021), Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400ft-lbf/ft³) (600kN-m/m³).
 - .4 ASTM D4318-17e1, Standard Test Methods for Liquid Limit, Plastic Limit and Plasticity Index of Soils.
- .2 Canadian General Standards Board (CGSB)
 - .1 CAN/CGSB-8.2-M88, Sieves, Testing, Woven Wire, Metric.
- .3 Ontario Provincial Standards Specification (OPSS).
 - .1 OPSS Muni 1010, Material Specification for Aggregate - Base, Sub-Base, Select Subgrade and Backfill Material.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Submit to DCC Representative quality control inspection and testing results/reports as described in PART 3 of this Section.

1.4 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, stockpile, store and handle materials in accordance with Section 31 05 16 - Aggregate Materials.

Part 2 Products

2.1 MATERIALS

- .1 Granular sub-base material: in accordance with Section 31 05 16 - Aggregate Materials and following requirements:
 - .1 Granular B Type I in accordance with OPSS Muni 1010.

Part 3 Execution

3.1 PREPARATION

- .1 Contractor shall submit a sediment and erosion control plan.

3.2 PLACING

- .1 Place granular base after subgrade surface is inspected and approved by DCC Representative.
- .2 Construct granular sub-base to depth and grade in areas indicated.
 - .1 In parking lots, laneways and taxiways without curbs, granular base and sub-base is to extend a minimum of 0.3m beyond the paving limits.
- .3 Ensure no frozen material is placed.
- .4 Place material only on clean unfrozen surface, free from snow or ice.
- .5 Begin spreading sub-base material on crown line or high side of one-way slope.
- .6 Place granular sub-base materials using methods which do not lead to segregation or degradation.
- .7 For spreading and shaping material, use spreader boxes having adjustable templates or screeds which will place material in uniform layers of required thickness.
- .8 Place material to full width in uniform layers not exceeding 150 mm compacted thickness.
- .9 Shape each layer to smooth contour and compact to specified density before succeeding layer is placed.
- .10 Remove and replace portion of layer in which material has become segregated during spreading.

3.3 COMPACTION

- .1 Compaction equipment to be capable of obtaining required material densities.
- .2 Compact to density of not less than 98% standard proctor maximum dry density in accordance with ASTM D 698.
- .3 Shape and roll alternately to obtain smooth, even and uniformly compacted sub-base.
- .4 Apply water as necessary during compaction to obtain specified density.
- .5 In areas not accessible to rolling equipment, compact to specified density with mechanical tampers approved by DCC Representative.
- .6 Correct surface irregularities by loosening and adding or removing material until surface is within specified tolerance.

3.4 PROOF ROLLING

- .1 Proof rolling in accordance with the following:

- .1 For proof rolling use standard roller of 45400 kg gross mass with four pneumatic tires each carrying 11350 kg and inflated to 620 kPa. Four tires arranged abreast with centre to centre spacing of 730 mm maximum.
- .2 Contractor may request in writing use of non-standard proof rolling equipment from the DCC Representative. Contractor must provide justification for use of non-standard proof rolling equipment from a certified geotechnical company.
 - .1 The acceptance or rejection of the request by the DCC Representative does not alleviate the contractor's responsibility to provide acceptable proof rolling and/or compaction.
- .3 Proof roll at level in sub-base as indicated.
 - .1 If non standard proof rolling equipment is approved, Contractor to have certified geotechnical company determine level of proof rolling, with the approval of the DCC Representative.
- .4 Make sufficient passes with proof roller to subject every point on surface to three separate passes of loaded tire.
- .5 Where proof rolling reveals areas of defective subgrade:
 - .1 Notify DCC Representative immediately.
 - .2 Remove sub-base and subgrade material to depth and extent as directed by DCC Representative.
 - .3 Backfill excavated subgrade with sub-base material and compact in accordance with this section.
 - .4 Replace sub-base material and compact.
- .2 Where proof rolling reveals areas of defective sub-base, remove and replace in accordance with this section at no extra cost to DCC or the Owner.

3.5 QUALITY CONTROL

- .1 The Contractor shall be responsible for all quality control inspection, laboratory testing and compaction testing.
- .2 Laboratory testing shall be performed on the sub-base material to determine the optimum moisture content (OMC) and maximum dry density (MDD), required for compaction testing, and in accordance with Section 31 05 16 - Aggregate Materials.
- .3 All compaction testing must be carried out by a qualified technician, trained in safe operation, transportation and handling of nuclear gauge. Technician performing compaction tests to be on-site during all compaction operations.
- .4 Minimum testing frequency:
 - .1 Earth embankments, granular base, granular subbase, and granular shoulders:
 - .1 Every lift, 3 test per location (access to hangar, access road to tank, along duct bank from Building 667 to Building 526)
 - .2 Structure backfill and sewer and water bedding, embedment, cover, or backfill material, granular:
 - .1 Every lift, and every 20m of placement, minimum 2 tests per utility trench.
- .5 Submit compaction test results at the completion of each day to DCC Representative for review.

- .6 Contractor shall conduct and submit satisfactory compaction test results to DCC Representative prior to placement of subsequent material. The DCC Representative will not consider payment for placement of any material unless satisfactory quality control test results are submitted by the Contractor.
- .7 All costs associated with quality control inspection and testing will be borne by the Contractor.
- .8 DCC Representative may conduct own Quality Assurance testing on materials as deemed appropriate at own cost.
- .9 Quality assurance inspection or testing by the DCC Representative will not augment or replace Contractor quality control nor relieve Contractor of his contractual responsibility.

3.6 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.
 - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.

3.7 SITE TOLERANCES

- .1 Finished sub-base surface to be within 10 mm of elevation as indicated but not uniformly high or low.

3.8 PROTECTION

- .1 Maintain finished sub-base in condition conforming to this section until succeeding base is constructed, or until granular sub-base is accepted by DCC Representative.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 31 05 16 - Aggregate Materials.
- .2 Section 32 11 16.01 - Granular Sub-Base

1.2 REFERENCE STANDARDS

- .1 ASTM International
 - .1 ASTM C136/C136M19, Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates.
 - .2 ASTM D698-12 (2021), Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400ft-lbf/ft³) (600kN-m/m³).
 - .3 ASTM D4318-17e1, Standard Test Methods for Liquid Limit, Plastic Limit and Plasticity Index of Soils.
- .2 Canadian General Standards Board (CGSB)
 - .1 CAN/CGSB-8.2-M88, Sieves, Testing, Woven Wire, Metric.
- .3 Ontario Provincial Standard Specification (OPSS).
 - .1 OPSS Muni 1010 Aggregates - Base, Subbase Select Subgrade, and Backfill Material.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Submit to DCC Representative quality control inspection and testing results and reports as described in PART 3 of this Section.

1.4 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, stockpile, store and handle materials in accordance with Section 31 05 16 - Aggregate Materials.

Part 2 Products

2.1 MATERIALS

- .1 Granular base: material in accordance with Section 31 05 16 - Aggregate Materials and following requirements:
 - .1 Granular A material as per OPSS Muni 1010

Part 3 Execution

3.1 PREPARATION

- .1 Contractor shall submit a sediment and erosion control plan ss per Section 01 35 43 - Environmental Procedures.

3.2 PLACING

- .1 Place granular base after granular sub-base surface is inspected and approved by DCC Representative.
- .2 Construct granular base to depth and grade in areas indicated.
 - .1 In parking lots, laneways and taxiways without curbs, granular base is to extend a minimum of 300mm beyond the paving limits.
- .3 Ensure no frozen material is placed.
- .4 Place material only on clean unfrozen surface, free from snow and ice.
- .5 Begin spreading base material on crown line or on high side of one-way slope.
- .6 Place material using methods which do not lead to segregation or degradation of aggregate.
- .7 Place material to full width in uniform layers not exceeding 150 mm compacted thickness.
 - .1 DCC Representative may authorize thicker lifts (layers) if specified compaction can be achieved.
- .8 Shape each layer to smooth contour and compact to specified density before succeeding layer is placed.
- .9 Remove and replace that portion of layer in which material becomes segregated during spreading.

3.3 COMPACTION

- .1 Ensure compaction equipment is capable of obtaining required material densities.
- .2 Compact to density not less than 98% standard proctor maximum dry density to ASTM D 698.
- .3 Shape and roll alternately to obtain smooth, even and uniformly compacted base.
- .4 Apply water as necessary during compacting to obtain specified density.
- .5 In areas not accessible to rolling equipment, compact to specified density with mechanical tampers approved in writing by DCC Representative.
- .6 Correct surface irregularities by loosening and adding or removing material until surface is within specified tolerance.

3.4 PROOF ROLLING

- .1 For proof rolling use standard roller of 45400 kg gross mass with four pneumatic tires each carrying 11350 kg and inflated to 620 kPa. Four tires arranged abreast with centre to centre spacing of 730 mm.
- .2 Contractor may request in writing use of non-standard proof rolling equipment from the DCC Representative. Contractor must provide justification for use of non-standard proof rolling equipment from a certified geotechnical company.
 - .1 The acceptance or rejection of the request by the DCC Representative does not alleviate the contractor's responsibility to provide acceptable proof rolling and/or compaction.
- .3 Proof roll at level in granular base as indicated.
 - .1 If non-standard proof rolling equipment is approved, Contractor to have certified geotechnical company determine level of proof rolling, with the approval of the DCC Representative.
- .4 Make sufficient passes with proof roller to subject every point on surface to three separate passes of loaded tire.
- .5 Where proof rolling reveals areas of defective subgrade:
 - .1 Notify DCC Representative immediately.
 - .2 Remove base, sub-base and subgrade material to depth and extent as directed by DCC Representative.
 - .3 Backfill excavated subgrade with material as directed by DCC Representative.
 - .4 Replace sub-base material and compact in accordance with Section 32 11 16.01 - Granular Sub-base.
 - .5 Replace base material and compact in accordance with Section 31 05 16 - Aggregate Materials and this Section.
- .6 Where proof rolling reveals defective base, remove defective materials to depth and extent as directed by DCC Representative and replace with new materials in accordance with this section at no extra cost to DCC or the Owner.

3.5 SITE TOLERANCES

- .1 Finished base surface to be within plus or minus 10 mm of established grade and cross section but not uniformly high or low.

3.6 QUALITY CONTROL

- .1 The Contractor shall be responsible for all quality control inspection, laboratory testing and compaction testing.
- .2 Laboratory testing shall be performed on the granular base to determine the optimum moisture content (OMC) and maximum dry density (MDD), required for compaction testing, and in accordance with Section 31 05 16 - Aggregate Materials.
- .3 All compaction testing must be carried out by a qualified technician, trained in safe operation, transportation and handling of nuclear gauge. Technician performing compaction tests to be on-site during all compaction operations.

- .4 Minimum testing frequency:
 - .1 Earth embankments, granular base, granular subbase, and granular shoulders:
 - .1 Every lift, 3 test per location (access to hangar and access road to tank)
 - .2 Structure backfill and sewer and water bedding, embedment, cover, or backfill material, granular:
 - .1 Every lift, and every 20m of placement, minimum 2 tests per utility trench.
- .5 Submit compaction test results at the completion of each day to DCC Representative for review.
- .6 Contractor shall conduct and submit satisfactory compaction test results to DCC Representative prior to placement of subsequent material. The DCC Representative will not consider payment for placement of any material unless satisfactory quality control test results are submitted by the Contractor.
- .7 All costs associated with quality control inspection and testing will be borne by the Contractor.
- .8 DCC Representative may conduct own Quality Assurance testing on materials as deemed appropriate at own cost.
- .9 Quality assurance inspection or testing by the DCC Representative will not augment or replace Contractor quality control nor relieve Contractor of his contractual responsibility.

3.7 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.
 - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.

3.8 PROTECTION

- .1 Maintain finished base in condition conforming to this Section until succeeding material is applied or until acceptance by DCC Representative.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 31 05 16 - Aggregate Materials.
- .2 Section 32 11 16.01 - Granular Sub-Base
- .3 Section 32 11 23 - Aggregate Base Courses.

1.2 REFERENCE STANDARDS

- .1 American Association of State Highway and Transportation Officials (AASHTO)
 - .1 AASHTO M320-16, Standard Specification for Performance Graded Asphalt Binder.
 - .2 AASHTO R29-15 (2019), Standard Specification for Grading or Verifying the Performance Graded of an Asphalt Binder.
 - .3 AASHTO T245-97(2008), Standard Method of Test for Resistance to Plastic flow of Bituminous Mixtures Using Marshall Apparatus.
- .2 Asphalt Institute (AI)
 - .1 AI MS-2-2015, SEVENTH Edition, Mix Design Methods for Asphalt Concrete and Other Hot-Mix Types.
- .3 ASTM International
 - .1 ASTM C 88-13, Standard Test Method for Soundness of Aggregates by Use of Sodium Sulphate or Magnesium Sulphate.
 - .2 ASTM D1140-17, Standard Test Method for Material Finer Than 0.075mm (No.200) Sieve in Mineral Aggregates by Washing.
 - .3 ASTM C123/123M-23, Standard Test Method for Lightweight Particles in Aggregate.
 - .4 ASTM C 128-22, Standard Test Method for Density, Relative Density (Specific Gravity), and Absorption of Fine Aggregate.
 - .5 ASTM C131/C131M-20, Standard Test Method for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine.
 - .6 ASTM C136/C136M-19, Standard Method for Sieve Analysis of Fine and Coarse Aggregates.
 - .7 ASTM C207-18, Standard Specification for Hydrated Lime for Masonry Purposes.
 - .8 ASTM D2419-22, Standard Test Method for Sand Equivalent Value of Soils and Fine Aggregate.
 - .9 ASTM D 3203-22 Standard Test Method for Percent Air Voids in Compacted Asphalt Mixtures.
 - .10 ASTM D4791-19 (2023), Standard Test Method for Flat Particles, Elongated Particles, or Flat and Elongated Particles in Coarse Aggregate.
- .4 Canadian General Standards Board (CGSB)
 - .1 CAN/CGSB-8.1-88, Sieves Testing, Woven Wire, Inch Series.
 - .2 CAN/CGSB-8.2-M88, Sieves Testing, Woven Wire, Metric.

- .5 Ontario Provincial Standard Specification (OPSS):
 - .1 OPSS Muni 310 - Construction Specification For Hot Mix Asphalt
 - .2 OPSS Muni 1003 - Material Specification For Aggregates-Hot Mix Asphalt
 - .3 OPSS Muni 1101 - Material Specification For Performance Graded Asphalt Cement
 - .4 OPSS Muni 1150 - Material Specification For Hot Mix Asphalt
 - .5 OPSS Muni 1151 - Material Specification For Superpave And Stone Mastic Asphalt Mixtures

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 – Submittal Procedures.
- .2 Product Data:
 - .1 Submit asphalt mix design and trial mix test results to DCC Representative for review at least 2 weeks prior to beginning Work.
- .3 Samples:
 - .1 Inform DCC Representative of proposed source of aggregates and provide access for sampling at least 2 weeks prior to beginning Work.
- .4 Test and Evaluation Reports:
 - .1 Submit to DCC Representative inspection and testing results and reports as described in PART 3 of this Section.
 - .2 Submit printed record of mix temperatures at end of each paving day.

Part 2 Products

2.1 ASPHALT MATERIALS

- .1 Performance graded asphalt cement: to AASHTO M320, grade PG 58-34 when tested to AASHTO R29.
- .2 Pavement Structure: to match existing conditions onsite, and shall be a minimum of:
 - .1 40mm Surface Course: Superpave 12.5 PG58-34 Traffic Level BLEVEL Bmm Binder Course: Superpave 12.5 PG58-34 Traffic Level B 150mm Granular A Base: as per Section 32 11 23 - Aggregate Base Courses
 - .2 300mm Granular B Sub-base: as per Section 32 11 16.01 - Granular Sub-Base
- .3 All materials shall conform to the requirements of OPSS Muni 310, OPSS Muni 1003, OPSS Muni 1101, OPSS Muni 1150 and OPSS Muni 1151.

2.2 ASPHALT TACK COAT

- .1 Asphalt Tack Coat: grade SS-1, as per OPSS Muni 310.

2.3 EQUIPMENT

- .1 All equipment shall conform to the requirements of OPSS Muni 310.

2.4 MIX DESIGN

- .1 Mix design to be approved in writing by DCC Representative.

Part 3 Execution

3.1 PLANT AND MIXING REQUIREMENTS

- .1 Plant to be Ministry of Transportation (MTO) approved.
- .2 Plant to be in accordance with OPSS Muni 1150 or OPSS Muni 1151.

3.2 PREPARATION

- .1 In areas where trenching is required to replace/install utilities, full depth replacement of asphalt pavement structure (sub-base, base and asphalt courses) in in accordance with Section 32 11 16.01 - Granular Sub-base and Section 32 11 23 - Aggregate Base Courses.
- .2 Apply tack coat prior to paving surface course.
- .3 Prior to laying mix, clean surfaces of loose and foreign material.

3.3 TRANSPORTATION OF MIX

- .1 Transport mix to job site in vehicles cleaned of foreign material.
- .2 Deliver material to paver at uniform rate and in an amount within capacity of paving and compacting equipment.
- .3 Deliver loads continuously in covered vehicles and immediately spread and compact.
 - .1 Deliver and place mixes at temperature within range as directed by DCC Representative, but not less than 135 degrees C.

3.4 PLACING

- .1 Obtain DCC Representative's approval prior to placing asphalt.
- .2 Place asphalt concrete to thicknesses, grades and lines as indicated.
- .3 Placing conditions:
 - .1 Place asphalt mixtures only when air temperature is 5 degrees C minimum.
 - .2 When temperature of surface on which material is to be placed falls below 10 degrees C, provide extra rollers as necessary to obtain required compaction before cooling.
 - .3 Do not place hot-mix asphalt when pools of standing water exist on surface to be paved, during rain, or when surface is damp.
- .4 Place asphalt concrete in compacted lifts of thickness as indicated.
- .5 Where possible do tapering and levelling where required in lower lifts. Overlap joints by not less than 300 mm.

3.5 COMPACTING

- .1 Compact asphalt in accordance with OPSS Muni 310 and the following.
 - .1 Compaction shall be accomplished using the minimum combination number of rollers specified in Table 5 of OPSS Muni 310.
 - .2 The Contractor shall determine the correct sequence of rollers used for compacting in order to achieve compaction requirements.
 - .3 The operating speed of steel drum rollers shall not exceed 5 km/h and shall be operated in a manner to avoid undue displacement of the mix.
 - .4 Rollers shall operate with the drive wheel forward in the direction of paving. Rolling procedures shall be as follows:
 - .1 Breakdown Rolling: The mix shall be uniformly compacted as soon after placing as it can support the roller without checking or undue displacement. Rolling shall start longitudinally at the lower edge and proceed towards the higher edge of the course, overlapping on successive passes. Alternate passes of the roller shall be staggered.
 - .2 Intermediate Rolling: The intermediate roller shall follow the breakdown roller as closely as possible. Passes shall overlap previous passes. The roller shall be operated to prevent pick-up of the HMA on the tires.
 - .3 Finish Rolling: Finish rolling shall start longitudinally at the higher edge and proceed towards the lower edge.
 - .5 At all places not accessible to rollers, the mix shall be compacted by mechanical, self-powered gas, electric, or air powered equipment.
- .2 Minimum asphalt compaction requirements based on maximum relative density are to be as per the following table:

Mix	Minimum Compaction %
HDBC, Superpave 19.0, 25.0	91.0
All Other Mixes	92.0

3.6 JOINTS

- .1 General:
 - .1 Remove surplus material from surface of previously laid strip.
 - .1 Do not deposit on surface of freshly laid strip.
 - .2 Construct joints between asphalt concrete pavement and Portland cement concrete pavement as indicated.
 - .3 Paint contact surfaces of existing structures such as manholes, curbs or gutters with bituminous material prior to placing adjacent pavement.
- .2 Transverse joints:
 - .1 Offset transverse joint in succeeding lifts by at least 600 mm.
 - .2 Cut back to full depth vertical face and tack face with thin coat of hot asphalt prior to continuing paving.
 - .3 Compact transverse joints to provide smooth riding surface. Use methods to prevent rounding of compacted surface at joints.
- .3 Longitudinal joints:

- .1 Offset longitudinal joints in succeeding lifts by at least 300 mm.
 - .2 Cold joint is defined as joint where asphalt mix is placed, compacted and left to cool below 100 degrees C prior to paving of adjacent lane.
 - .1 For airfield runway paving, avoid cold joint construction in mid 30 m of runway.
 - .2 If cold joint can not be avoided, cut back by saw cutting previously laid lane, by at least 300 mm, to full depth vertical face, and tack face with thin coat of hot asphalt of adjacent lane.
 - .3 Overlap previously laid strip with spreader by 25 to 50 mm.
 - .4 Before rolling, carefully remove and discard coarse aggregate in material overlapping joint with lute or rake.
 - .5 Roll longitudinal joints directly behind paving operation.
 - .6 When rolling with static or vibratory rollers, have most of drum width ride on newly placed lane with remaining 150 mm extending onto previously placed and compacted lane.
- .4 Construct butt joints as indicated.

3.7 SURFACE APPEARANCE

- .1 Each course after final compaction shall be of uniform texture and shall be free of defects such as segregation, fat spots, oil spills, and roller marks. Defective areas shall be removed and replaced with HMA of the same type and compacted to the satisfaction of the DCC Representative.
- .2 If the Contractor's actions fail to prevent continued medium or severe segregation regardless of cause, the DCC Representative may instruct the Contractor to cease paving until the problem has been corrected.

3.8 QUALITY CONTROL

- .1 The Contractor shall be responsible for all quality control inspection, laboratory testing and compaction testing.
- .2 All compaction testing must be carried out by a qualified technician, trained in safe operation, transportation and handling of nuclear gauge. Technician performing compaction tests to be on-site during all compaction operations.
- .3 Minimum testing frequency:
 - .1 Asphalt cement content and gradation:
 - .1 1 test for each 500 tonnes of placement, with a minimum of 1 per asphalt mix.
 - .2 Asphalt full compliance testing (Marshall properties or Superpave properties):
 - .1 1 test for each 1,000 tonnes of placement per asphalt mix.
 - .3 Asphalt (surface and binder course) compaction testing:
 - .1 Compaction testing shall be conducted randomly at a minimum frequency of 4 each along each of the access road to hangar, access road to tank pavement areas, and along duct bank from Building 667 to Building 526.
- .4 Submit compaction test results at the completion of each day to DCC Representative for review.

- .5 Contractor shall conduct and submit satisfactory compaction test results to DCC Representative prior to placement of subsequent material. The DCC Representative will not consider payment for placement of any material unless satisfactory quality control test results are submitted by the Contractor.
- .6 All costs associated with quality control inspection and testing will be borne by the Contractor.
- .7 DCC Representative may conduct own Quality Assurance testing on materials as deemed appropriate at own cost.
- .8 Quality assurance inspection or testing by the DCC Representative will not augment or replace Contractor quality control nor relieve Contractor of his contractual responsibility.

3.9 FINISH TOLERANCES

- .1 Finished asphalt surface to be within 5 mm of design elevation but not uniformly high or low.
- .2 Finished asphalt surface not to have irregularities exceeding 5 mm when checked with 4.5 m straight edge placed in any direction.

3.10 DEFECTIVE WORK

- .1 Correct irregularities which develop before completion of rolling by loosening surface mix and removing or adding material as required.
 - .1 If irregularities or defects remain after final compaction, remove surface course promptly and lay new material to form true and even surface and compact immediately to specified density.
- .2 Repair areas showing checking, rippling, or segregation.
- .3 Adjust roller operation and screed settings on paver to prevent further defects such as rippling and checking of pavement.

3.11 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.
 - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

- .1 Section 32 92 23 – Sodding.

1.2 REFERENCES

- .1 Agriculture and Agri-Food Canada
 - .1 The Canadian System of Soil Classification, Third Edition, 1998.
- .2 Canadian Council of Ministers of the Environment
 - .1 PN1340-2005, Guidelines for Compost Quality.

1.3 DEFINITIONS

- .1 Compost:
 - .1 Mixture of soil and decomposing organic matter used as fertilizer, mulch, or soil conditioner.
 - .2 Compost is processed organic matter containing 40% or more organic matter as determined by Walkley-Black or Loss On Ignition (LOI) test.
 - .3 Product must be sufficiently decomposed (i.e. stable) so that any further decomposition does not adversely affect plant growth (C:N ratio below (25) (50)), and contain no toxic or growth inhibiting contaminants.
 - .4 Composed bio-solids to: CCME Guidelines for Compost Quality, Category (A) (B).

Part 2 Products

2.1 TOPSOIL

- .1 Import topsoil for sodded areas: mixture of particulates, micro organisms and organic matter which provides suitable medium for supporting intended plant growth.
 - .1 Contain no toxic elements or growth inhibiting materials.
- .2 Finished surface free from:
 - .1 Debris and stones over 50 mm diameter.
 - .2 Course vegetative material, 10 mm diameter and 100 mm length, occupying more than 2% of soil volume.
 - .3 Consistence: friable when moist.

2.2 SOIL AMENDMENTS

- .1 Fertilizer:
 - .1 Complete commercial fertilizer with minimum 65% insoluble nitrogen.
- .2 Sand: washed coarse silica sand, medium to course textured.

Part 3 Execution

3.1 PREPARATION OF EXISTING GRADE

- .1 Verify that grades are correct.
 - .1 If discrepancies occur, notify DCC Representative and do not commence work until instructed by DCC Representative.

- .2 Grade soil, eliminating uneven areas and low spots, ensuring positive drainage.
- .3 Remove debris, roots, branches, stones in excess of 50mm diameter and other deleterious materials.
 - .1 Remove soil contaminated with calcium chloride, toxic materials and petroleum products.
 - .2 Remove debris which protrudes more than 75 mm above surface.

3.2 PLACING AND SPREADING OF TOPSOIL/PLANTING SOIL

- .1 Place topsoil after DCC Representative has accepted subgrade.
- .2 Spread topsoil in uniform layers not exceeding 100 mm.
- .3 For sodded areas keep topsoil 15mm below finished grade.
- .4 Spread topsoil as indicated to following minimum depths after settlement.
 - .1 100 mm for sodded areas.
- .5 Manually spread topsoil/planting soil around trees, shrubs and obstacles.

3.3 FINISH GRADING

- .1 Grade to eliminate rough spots and low areas and ensure positive drainage.
 - .1 Prepare loose friable bed by means of cultivation and subsequent raking.
- .2 Consolidate topsoil to required bulk density using equipment approved by DCC Representative.
 - .1 Leave surfaces smooth, uniform and firm against deep footprinting.

3.4 ACCEPTANCE

- .1 DCC Representative will inspect and test topsoil in place and determine acceptance of material, depth of topsoil and finish grading.

3.5 SURPLUS MATERIAL

- .1 Dispose of materials except topsoil not required off site.

3.6 CLEANING

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

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 32 91 19.13 - Topsoil Placement and Grading.

1.2 ADMINISTRATIVE REQUIREMENTS

- .1 Scheduling:
 - .1 Schedule sod laying to coincide with preparation of soil surface.
 - .2 Schedule sod installation when frost is not present in ground.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

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

1.4 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with manufacturer's written instructions.
- .2 Storage and Handling Requirements:
 - .1 Store materials in accordance with supplier's recommendations.
 - .2 Replace defective or damaged materials with new.

Part 2 Products

2.1 MATERIALS

- .1 Number One Turf Grass Nursery Sod: sod that has been especially sown and cultivated in nursery fields as turf grass crop.
 - .1 Turf Grass Nursery Sod types:
 - .1 Number One Kentucky Bluegrass Sod: Nursery Sod grown solely from seed of cultivars of Kentucky Bluegrass, containing not less than 50% Kentucky Bluegrass cultivars.
 - .2 Number One Kentucky Bluegrass Sod - Fescue Sod: Nursery Sod grown solely from seed mixture of cultivars of Kentucky Bluegrass and Chewing Fescue or Creeping Red Fescue, containing not less than 40% Kentucky Bluegrass cultivars and 30% Chewing Fescue or Creeping Red Fescue cultivars.
 - .3 Number One Named Cultivars: Nursery Sod grown from certified seed.
 - .2 Turf Grass Nursery Sod quality:
 - .1 Not more than 1 broadleaf weed and up to 1% native grasses per 40 m².
 - .2 Density of sod sufficient so that no soil is visible from height of 1500 mm when mown to height of 50 mm.
 - .3 Mowing height limit: 35 to 65 mm.
 - .4 Soil portion of sod: 6 to 15 mm in thickness.
- .2 Fertilizer:

- .1 To Canada "Fertilizers Act" and Fertilizers Regulations.
- .2 Complete, synthetic, slow release with 65 % of nitrogen content in water-insoluble form.

2.2 SOURCE QUALITY CONTROL

- .1 Obtain written approval from DCC Representative of sod at source.
- .2 When proposed source of sod is approved, use no other source without written authorization from DCC Representative.

Part 3 Execution

3.1 PREPARATION

- .1 Verify that grades are correct and prepared in accordance with Section 32 91 19.13 - Topsoil Placement and Grading. If discrepancies occur, notify DCC Representative and do not commence work until instructed by DCC Representative.
- .2 Do not perform work under adverse field conditions such as frozen soil, excessively wet soil or soil covered with snow, ice, or standing water.
- .3 Fine grade surface free of humps and hollows to smooth, even grade, to contours and elevations indicated, to tolerance of plus or minus 8 mm, for Turf Grass Nursery Sod, surface to drain naturally.
- .4 Remove and dispose of weeds; debris; stones 50 mm in diameter and larger; soil contaminated by oil, gasoline and other deleterious materials; off site.

3.2 SOD PLACEMENT

- .1 Lay sod within 24 hours of being lifted if air temperature exceeds 20 degrees C.
- .2 Lay sod sections in rows, joints staggered. Butt sections closely without overlapping or leaving gaps between sections. Cut out irregular or thin sections with sharp implements.
- .3 Roll sod as directed by DCC Representative. Provide close contact between sod and soil by light rolling. Use of heavy roller to correct irregularities in grade is not permitted.

3.3 SOD PLACEMENT ON SLOPES AND PEGGING

- .1 Install and secure geotextile fabric in areas indicated, in accordance with manufacturer's instructions.
- .2 Start laying sod at bottom of slopes.
- .3 Peg sod on slopes steeper than 3 horizontal to 1 vertical, within 1 m of catch basins and within 1 m of drainage channels and ditches to following pattern:
 - .1 100 mm below top edge at 200 mm on centre for first sod sections along contours of slopes.
 - .2 Not less than 3-6 pegs per square metre.
 - .3 Not less than 6-9 pegs per square metre in drainage structures. Adjust pattern as directed by DCC Representative.
 - .4 Drive pegs to 20 mm above soil surface of sod sections.

3.4 FERTILIZING PROGRAM

- .1 Contractor to develop fertilizing program in order to conform to acceptance requirements in accordance with the ACCEPTANCE section below.

3.5 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.
 - .1 Leave Work area clean at end of each day.
 - .2 Keep pavement and area adjacent to site clean and free from mud, dirt, and debris at all times.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.

3.6 MAINTENANCE DURING ESTABLISHMENT PERIOD

- .1 Perform following operations from time of installation until acceptance.
 - .1 Water sodded areas in sufficient quantities and at frequency required to maintain optimum soil moisture condition to depth of 75 to 100 mm.
 - .2 Cut grass to 50 mm when or prior to it reaching height of 75 mm.
 - .3 Maintain sodded areas weed free to 95%.
 - .4 Temporary barriers or signage to be maintained where required to protect newly established sod.

3.7 ACCEPTANCE

- .1 Turf Grass Nursery Sod areas will be accepted by DCC Representative provided that:
 - .1 Sodded areas are properly established.
 - .2 Sod is free of bare and dead spots.
 - .3 No surface soil is visible from height of 1500 mm when grass has been cut to height of 50 mm.
 - .4 Sodded areas have been cut minimum 2 times prior to acceptance.
- .2 Areas sodded in fall will be accepted in following spring one month after start of growing season provided acceptance conditions are fulfilled.
- .3 When environmental conditions allow, all sodded areas showing shrinkage cracks shall be top-dressed and seeded with a seed mix matching the original.

3.8 MAINTENANCE DURING WARRANTY PERIOD

- .1 Perform following operations from time of acceptance until end of warranty period:
 - .1 Water sodded Turf Grass Nursery Sod areas at weekly intervals to obtain optimum soil moisture conditions to depth of 100 mm.
- .2 Repair and resod dead or bare spots to satisfaction of DCC Representative.
- .3 Cut grass and remove clippings as directed by DCC Representative

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 31 23 33.01 – Excavating, Trenching and Backfilling

1.2 REFERENCE STANDARDS

- .1 MTO OPSS 441 Construction Specification for Watermain Installation in Open Cut.
- .2 American National Standards Institute/American Water Works Association (ANSI/AWWA)
1. ANSI/AWWA B300-10, Standard for Hypochlorites.
 2. ANSI/AWWA B301-10, Standard for Liquid Chlorine.
 3. ANSI/AWWA B303-10, Standard for Sodium Chlorite.
 4. ANSI/AWWA C104/A21.4-08, Standard for Cement-Mortar Lining for Ductile-Iron Pipe and Fittings.
 5. ANSI/AWWA C111/A21.11-07, American National Standard for Rubber-Gasket Joints for Ductile-Iron and Fittings.
 6. ANSI/AWWA C110/A21.10-08, American National Standard for Ductile-Iron and Grey Iron Fittings for Water.
 7. ANSI/AWWA C150/A21.50-08, Standard for Thickness Design of Ductile-Iron Pipe.
 8. ANSI/AWWA C151/A21.51-09, Standard for Ductile-Iron Pipe, Centrifugally Cast.
 9. ANSI/AWWA C153/A21.53-11, Standard for Ductile-Iron Compact Fittings.
 10. ANSI/AWWA C500-09, Standard for Metal-Seated Gate Valves for Water Supply Service.
 11. ANSI/AWWA C600-10, Standard for Installation of Ductile-Iron Water Mains, and Their Appurtenances.
 12. ANSI/AWWA C651-05, Standard for Disinfecting Water Mains.
 13. ANSI/AWWA C800-05, Standard for Underground Service Line Valves and Fittings.
 14. ANSI/AWWA C900 Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 4 In. Through 60 In. (100 mm Through 1,500 mm).
- .3 ASTM International (ASTM)
1. ASTM A 123/A 123M-09, Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
 2. ASTM A 307-10, Standard Specification for Carbon Steel Bolts and Studs, 60,000 psi Tensile.
 3. ASTM C 117-04, Standard Test Methods for Material Finer Than 0.075 mm (No. 200) Sieve in Mineral Aggregates by Washing.
 4. ASTM C 136-06, Standard Method for Sieve Analysis of Fine and Coarse Aggregates.
 5. ASTM D 698-07e1, Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft³ (600 kN-m/m³)).
- .4 Canadian General Standards Board (CGSB)
1. CGSB 41-GP-25M-77, Pipe, Polyethylene, for the Transport of Liquids.

.5 CSA Group (CSA)

1. CAN/CSA-B137 Series-09, Thermoplastic Pressure Piping Compendium. (Consists of B137.0, B137.1, B137.2, B137.3, B137.4, B137.4.1, B137.5, B137.6, B137.8, B137.9, B137.10, B137.11 and B137.12).
2. CAN/CSA-B137.3-09, Rigid Polyvinyl Chloride (PVC) Pipe for Pressure Applications.
3. NFPA 24 Standard for the Installation of Private Fire Service Mains and Their Appurtenances

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Submit complete shop drawings and construction schedule for water mains.
- .3 Prior to the initiation of the watermain installation, the Contractor shall submit a Watermain Commissioning Plan (W.C.P.) for review by the DCC Representative.
 1. The W.C.P. shall contain a detailed description of all steps the Contractor will undertake to complete the installation of the watermain and successfully complete the commissioning of the watermain.
- .4 Inform DCC Representative of proposed source of bedding materials and provide access for sampling at least 4 weeks prior to commencing work.
- .5 Submit manufacturer's test data and certification that pipe materials meet requirements of this section at least 4 weeks prior to beginning work. Include manufacturer's drawings, information and shop drawings where pertinent.
- .6 Product Data:
 1. Pipe certification to be on pipe.

1.4 CLOSEOUT SUBMITTALS

- .1 Submit in accordance with Section 01 78 00 - Closeout Submittals.
- .2 Submit record drawings, including directions for operating valves, list of equipment required to operate valves, and details of pipe material.
 1. Include top of pipe, horizontal location of fittings and type, valves, and valve boxes.
- .3 Operation and Maintenance Data: submit operation and maintenance data for pipe, valves, valve boxes, valve chambers and hydrants for incorporation into manual.
- .4 Flushing and disinfecting contractor to submit certified copy of test result of the disinfection.

1.5 DELIVERY, STORAGE AND HANDLING

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

.3 Storage and Handling Requirements:

1. Store materials off ground indoors in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
2. Store and protect water distribution piping from nicks, scratches, and blemishes.
3. Replace defective or damaged materials with new.

1.6 SCHEDULING OF WORK

- .1 Schedule Work to minimize interruptions to existing services.
- .2 Submit schedule of expected interruptions for approval and adhere to interruption schedule as approved by DCC Representative.
- .3 Notify DCC Representative a minimum of 48 hours in advance of interruption in service.
- .4 Do not interrupt water service for more than 3 hours and confine this period between 10:00 and 16:00 hours local time unless otherwise authorized.
- .5 Notify fire department of planned or accidental interruption of water supply to hydrants.

1.7 MAINTENANCE MATERIAL SUBMITTALS

- .1 Submit in accordance with Section 01 78 00 - Closeout Submittals.
- .2 Tools: provide tools as follows:
 1. 2 tee-handle operating keys for valves.

Part 2 Products

2.1 PIPE, JOINTS AND FITTINGS

- .1 Polyvinyl chloride pressure pipe: PVC Class 150 DR-18 ANSI/AWWA C900.
 1. For 102mm water service, CAN/CSA-B137.3, PVC series 160, 1.1 MPa elastomeric gasket coupling.
- .2 Fusible Polyvinyl chloride pressure pipe: to ANSI/AWWA C900, pressure class 235, DR 14, 1 MPa gasket bell end, cast iron outside diameter.
- .3 Cast iron fittings: to ANSI/AWWA C110/A21.10, and for pipe diameters larger than NPS 4 cement mortar lined to ANSI/AWWA C104/A21.4.
- .4 Mechanical joint restraints are to be manufactured by Romac, Uni-Flange or Megalug.

2.2 PIPE PROTECTION

- .1 All PVC watermains shall have one 2.7 kg packaged zinc anode installed on every valve and fitting.
- .2 Fittings include bends, tees, crosses, sleeves, reducers, caps, plugs and couplings.

- .3 All watermain services shall have one 5.4 kg packaged zinc anode installed at the curb stop. The anode shall be connected to the copper tubing using an approved solid brass ground clamp.
- .4 All thermite weld connections to be covered with a thermite weld cap using an appropriate primer.
- .5 All sacrificial anodes shall conform to ASTM 418-95a Type II and shall be made of high grade electrolytic zinc 99.9% pure.

2.3 VALVES AND VALVE BOXES

- .1 Valves to open counter clockwise.
- .2 Gate valves: ANSI/AWWA C509, counter clockwise turn, standard brass valves, resilient seat, polished internals. Certified for potable water use. Flanged suitable for a minimum 1 MPa cold water working pressure.
- .3 Cast iron valve boxes: three piece sliding type adjustable over minimum of 450 mm.
 - 1. Base to be large round type with minimum diameter of 300 mm.
 - 2. Top of box to be marked "WATER".

2.4 PIPE BEDDING AND SURROUND MATERIAL

- .1 The pipe bedding and cover material shall be Granular 'A' conforming to the dimensions in OPSD 802.010.
- .2 Concrete mixes and materials required for bedding cradles, encasement, supports, thrust blocks: to Section 03 30 00 - Cast-in-Place Concrete.

2.5 BACKFILL MATERIAL

- .1 Granular A as indicated in accordance with Section 31 23 33.01 - Excavating, Trenching and Backfilling.

2.6 PIPE DISINFECTION

- .1 Sodium hypochlorite Liquid chlorine to ANSI/AWWA B300, ANSI/AWWA B301, ANSI/AWWA B303 to disinfect water mains.
- .2 Undertake disinfection of water mains in accordance with the greater criteria between:
 - 1. ANSI/AWWA C651
 - 2. 8 Wing Trenton Procedures for New Watermains within Appendix B for pre-service cleaning, testing and certification guidelines.

2.7 TRACER WIRE

- .1 All non-metallic mains and services shall be traced with a 10 gauge stranded copper, plastic coated tracer wire TWU 75C 600 V or pre-approved equal
- .2 Installation:

1. The tracing wire shall be laid flat and secured every 3m at the top or spring line of the watermain, hydrant laterals and water services as shown in the Contract drawings. Tracer wire shall be continuous and only unavoidable splicing shall be completed using Snake Bite DryConn 3-Way Direct Bury Lug.
 2. The tracer wire shall be installed securely outside of the main valve box, entering the valve box top section through the pre-cut hole and extending a minimum of 300 mm above finished grade at each main valve box. The tracer wire shall then be neatly wrapped and inserted into the valve box not to interfere with the placement of the lid.
 3. The water service lateral tracing wire shall extend from the main and be attached to the top 152mm of the service post using the appropriate brass ground clamp suitable for underground installations. The wire shall be stripped of insulation and passed through the clamp to make contact with the service box, for continuity purposes. The wire shall be loosely wrapped around the service box, extending a minimum of 300mm above the surface and then neatly wrapped around the service box for termination. The tracer wire at the main shall be carefully exposed and the service tracer wire shall be connected to the main tracer wire using "SnakeBite" DryConn 3-Way Direct Bury Lug. Care should be exercised as to not pull and damage the watermain wire when making the connection.
 4. Where PVC, HDPE or concrete watermains are to be connected to ductile iron or cast pipes the tracing wire shall be attached to the ductile iron or cast pipe by cadweld.
 5. At watermain end caps, approximately 3.0 m of tracing wire shall be extended, coiled and properly secured for future connections.
- .3 Splice Connections
- Splice connections shall be completed using Snake Bite DryConn 3-Way Direct Bury Lug. Prior to cutting the tracing wire for splice connections, the tracing wire shall be loose and not taut to avoid stretching.
- .4 Continuity Testing
1. Testing shall be done in the presence and to the satisfaction of the Contract Administrator with at least 48 hours' notice.
 2. The continuity tests shall be conducted after all services have been installed and before the base course of asphalt is applied.
 3. Tracing wire installations that fail the testing must be corrected and retested to the satisfaction of the Contract Administrator.

Part 3 Execution

3.1 EXAMINATION

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for distribution piping installation in accordance with manufacturer's written instructions.
1. Inform DCC Representative of unacceptable conditions immediately upon discovery.
 2. Proceed with installation only after unacceptable conditions have been remedied.

3.2 PREPARATION

- .1 Clean pipes, fittings, valves, hydrants, and appurtenances of accumulated debris and water before installation.

3.3 TEMPORARY SERVICES (NOT REQUIRED)

3.4 TRENCHING

- .1 Do trenching work in accordance with Section 31 23 33.01 - Excavating, Trenching and Backfilling.
- .2 Ensure trench depth allows coverage over pipe as indicated.
- .3 Trench alignment and depth require approval prior to placing bedding material and pipe.

3.5 REMOVALS

- .1 Remove and discard watermains, hydrants, valves and associated appurtenances as indicated, including non-native granular backfill.

3.6 PIPE ABANDONMENT

- .1 Abandon existing watermains, not already marked as abandoned, in place only if directed by DCC Representative.
 1. Expose and cut pipe ends.
 2. Drain pipe.
 3. Fill pipe with unshrinkable fill.

3.7 CAPPING

- .1 Cap existing watermain as indicated and as per manufacturer's instructions.

3.8 CONCRETE BEDDING AND ENCASEMENT

- .1 Do concrete work in accordance with Section 03 30 00 - Cast-in-Place Concrete.
 1. Place concrete to details as indicated.
- .2 Pipe may be positioned on concrete blocks to facilitate placing of concrete. When necessary, rigidly anchor or weight pipe to prevent flotation when concrete is placed.
- .3 Do not backfill over concrete within 24 hours after placing.

3.9 GRANULAR BEDDING

- .1 Place granular bedding material in uniform layers not exceeding 150 mm compacted thickness to depth as indicated.
- .2 Do not place material in frozen condition.
- .3 Shape bed true to grade to provide continuous uniform bearing surface for pipe.

- .4 Shape transverse depressions in bedding as required to suit joints.
- .5 Compact each layer full width of bed to 98% standard proctor maximum dry density to ASTM D 698.
- .6 Fill authorized or unauthorized excavation below design elevation of bottom of specified bedding in accordance with compacted bedding material.

3.10 PIPE INSTALLATION

- .1 Install coupling necessary for connection to building plumbing, if plumbing is already installed, make connection; otherwise cap or seal end of pipe and place temporary marker to locate pipe end.
- .2 Lay pipes to manufacturer's standard instructions and specifications.
- .3 Join pipes in accordance with manufacturer's recommendations.
- .4 Do not use chains or cables passed through pipe bore so that weight of pipe bears on pipe ends.
- .5 Lay pipes on prepared bed, true to line and grade.
 - 1. Ensure barrel of each pipe is in contact with shaped bed throughout its full length.
 - 2. Take up and replace defective pipe.
 - 3. Correct pipe which is not in true alignment or grade or pipe which shows differential settlement after installation greater than 10 mm in 3 m.
- .6 Face socket ends of pipe in direction of laying. For mains on grade of 2% or greater, face socket ends up-grade.
- .7 Do not exceed permissible deflection at joints as recommended by pipe manufacturer.
- .8 Keep jointing materials and installed pipe free of dirt and water and other foreign materials.
 - 1. Whenever work is stopped, install a removable watertight bulkhead at open end of last pipe laid to prevent entry of foreign materials.
- .9 Position and join pipes with equipment and methods approved by DCC Representative.
- .10 Cut pipes in approved manner as recommended by pipe manufacturer, without damaging pipe or its coating and to leave smooth end at right angles to axis of pipe.
- .11 Align pipes before jointing.
- .12 Install gaskets to manufacturer's recommendations. Support pipes with hand slings or crane as required to minimize lateral pressure on gasket and maintain concentricity until gasket is properly positioned.
- .13 Avoid displacing gasket or contaminating with dirt or other foreign material.
 - 1. Remove disturbed or contaminated gaskets.
 - 2. Clean, lubricate and replace before jointing is attempted again.
- .14 Complete each joint before laying next length of pipe.

- .15 Minimize deflection after joint has been made.
- .16 Apply sufficient pressure in making joints to ensure that joint is completed to manufacturer's recommendations.
- .17 Ensure completed joints are restrained by compacting bedding material alongside and over installed pipes.
- .18 When stoppage of work occurs, block pipes in an approved manner to prevent creep during down time.
- .19 Do not lay pipe on frozen bedding.
- .20 Do hydrostatic and leakage test and have results approved by DCC Representative before surrounding and covering joints and fittings with granular material.
- .21 Backfill remainder of trench.

3.11 VALVE INSTALLATION

- .1 Install valves to manufacturer's recommendations at locations as indicated.
- .2 Support valves located in valve boxes or valve chambers by means of concrete located between valve and solid ground. Maximum length of pipe on each end of valve shall be 1 m. Valves not to be supported by pipe.
- .3 Install underground post-type indicator valves as indicated.

3.12 PIPE CUTTING

- .1 PVC – Pipe Cutting
 - 1. PVC pipe may be cut with a fine-toothed hand saw, power saw or hacksaw; chain saws shall not be used. It is recommended that the pipe be marked around its entire circumference prior to cutting to assure a square cut. Use a factory-finished beveled spigot end as a guide for proper bevel angle, and depth of bevel plus the distance to the insertion mark. The end may be beveled using a pipe beveling tool or a wood rasp, portable sander or abrasive disc. Round off any sharp edges.
 - 2. Use a factory finished spigot end as a guide to determine the correct taper. The end may be beveled using specially designed tools for this work, portable sanders or a coarse, flat file. After cutting, draw a new and visible reference mark on the spigot end of the pipe. The reference mark is defined as the line marking the limit of insertion of the spigot end into the bell end of the pipe. The proper distance for the reference mark from the spigot end of the pipe shall be in accordance with the manufacturer's specifications for each size of pipe.
 - 3. Cut off the factory beveled end and provide approximately 3 mm of bevel when inserting into a push-on joint. No bevel is permitted for an MJ fitting.
 - 4. All cutting dust and debris shall be removed from the inside of the pipe prior to installation.

3.13 THRUST BLOCKS AND RESTRAINED JOINTS

.1 PVC - Mechanical Joint (MJ) Fittings

1. When assembling a mechanical joint, the manufacturer's instructions shall be followed and shall include the following for a mechanical joint wedge action restrainer:
 - .1 Slide on any restraining rings that may be required. Wipe clean the socket and the plain end. Apply a generous coating of lubricant to the exposed surface of the rubber gasket and a thin film to the outside edge of the plain end of the pipe for a distance of about 25 mm back from the end of the pipe. Only NSF approved lubricant, supplied by the manufacturer shall be used. The lubricant is furnished in sterile containers and every effort should be made to protect against contamination of the container's contents.
 - .2 Place the gland on the plain end with the lip extension toward the plain end, followed by the gasket with the narrow edge of the gasket toward the plain end.
 - .3 Insert the pipe into the socket and press the gasket firmly and evenly into the gasket recess. Keep the joint straight during the assembly.
 - .4 Push the gland toward the socket and center it around the pipe with the gland lip against the gasket. Insert bolts and hand tighten nuts. Make deflection after joint assembly but before tightening bolts. Tighten the bolts to 102 to 122 Nm (75 to 90 ft-lbs) (100 mm to 600 mm diameter), while at all times maintaining approximately the same distance between the gland and the face of the flange at all points around the socket. This can be accomplished by partially tightening the bottom bolt first, then the top bolt, next the bolts on either side, finally the remaining bolts. Repeat the process until all bolts are within the appropriate range of torque. Hand tighten the torque limiting twist-off nuts in a clockwise direction until all wedges are in firm contact with the pipe surface.
 - .5 Continue tightening in an alternating manner until all of the nuts have been twisted off. Never turn a single nut over 180 degrees without alternating to another nut. If removal is necessary, utilize the hex head provided. If reassembly is required, tighten the wedge bolt to 122 N-m.

.2 For thrust blocks: do concrete Work in accordance with Section 03 30 00 - Cast-in-Place Concrete.

.3 Place concrete thrust blocks between valves, tees, plugs, caps, bends, changes in pipe diameter, reducers, hydrants and fittings and undisturbed ground as indicated.

.4 Keep joints and couplings free of concrete.

.5 Do not backfill over concrete within 24 hours after placing.

.6 For restrained joints: only use restrained joints approved by DCC Representative.

3.14 HYDROSTATIC AND LEAKAGE TESTING

.1 Do tests in accordance with ANSI/AWWA C600 or C605 as well as in accordance with the 8 Wing Procedures for New Watermains within Appendix B.

.2 Provide labour, equipment and materials required to perform hydrostatic and leakage tests hereinafter described.

- .3 Notify DCC Representative at least 24 hours in advance of proposed tests.
 1. Perform tests in presence of DCC Representative.
- .4 Where section of system is provided with concrete thrust blocks, conduct tests at least 5 days after placing concrete or 2 days if high early strength concrete is used.
- .5 Upon completion of pipe laying and after DCC Representative has inspected Work in place, surround and cover pipes between joints with approved granular material placed to dimensions indicated.
- .6 Leave valves, joints and fittings exposed.
- .7 When testing is done during freezing weather, protect valves, joints and fittings from freezing.
- .8 Strut and brace caps, bends, tees, and valves, to prevent movement when test pressure is applied.
- .9 Open valves.
- .10 Expel air from main by slowly filling main with potable water.
 1. Install corporation stops at high points in main where no air-vacuum release valves are installed.
 2. Remove stops after satisfactory completion of test and seal holes with plugs.
- .11 Thoroughly examine exposed parts and correct for leakage as necessary.
- .12 Apply hydrostatic test pressure of 1.5 MPa minimum based on elevation of lowest point in main and corrected to elevation of test gauge, for period of 1 hour.
- .13 Examine exposed pipe, joints, fittings and appurtenances while system is under pressure.
- .14 Remove joints, fittings and appurtenances found defective and replace with new sound material and make watertight.
- .15 Repeat hydrostatic test until defects have been corrected.
- .16 Apply leakage test pressure of 1.5 Mpa minimum after complete backfilling of trench, based on elevation of lowest point in main and corrected to elevation of gauge, for period of 2 hours.
- .17 Define leakage as amount of water supplied from water storage tank in order to maintain test pressure for 2 hours.
- .18 Do not exceed allowable leakage of per manufacturer's instructions.
- .19 Locate and repair defects if leakage is greater than amount specified.
- .20 Repeat test until leakage is within specified allowance for full length of water main.

3.15 PIPE SURROUND

- .1 Upon completion of pipe laying and after DCC Representative has inspected Work in place, surround and cover pipes as indicated.

- .2 Hand place surround material in uniform layers not exceeding 150 mm compacted thickness as indicated.
 1. Do not dump material within 1 m of pipe.
- .3 Place layers uniformly and simultaneously on each side of pipe.
- .4 Do not place material in frozen condition.
- .5 Compact each layer from pipe invert to underside of backfill to at least 98% of standard proctor maximum dry density to ASTM D 698.

3.16 BACKFILL

- .1 Surround and cover pipes with 300 mm of compacted Granular A material and backfill per Section 31 23 33.01 Excavation, Trenching and Backfill.
- .2 Place backfill material, above pipe surround, in uniform layers not exceeding 150 mm compacted thickness up to grades as indicated.
- .3 Do not place backfill in frozen condition.
- .4 Compact each layer to at least 98% of standard proctor maximum dry density.

3.17 FLUSHING AND DISINFECTING

- .1 Flushing and disinfecting operations: witnessed by DCC Representative carried out by specialist contractor.
 1. Notify DCC Representative at least 4 days in advance of proposed date when disinfecting operations will begin.
- .2 Flush water mains through available outlets with a sufficient flow of potable water to produce velocity of 1.5 m/s, within pipe for minimum 10 minutes, or until foreign materials have been removed and flushed water is clear.
- .3 Flushing flows as follows:

Pipe Size NPS	Flow (L/s) Minimum
6 and below	38
8	75
10	115
12	150
16	TBD
- .4 Provide connections and pumps for flushing as required.
- .5 Open and close valves, hydrants and service connections to ensure thorough flushing.
- .6 When flushing has been completed to introduce strong solution of chlorine into water main and ensure that it is distributed throughout entire system.
- .7 Specialist contractor to perform disinfection. Disinfect water mains to the requirements of local authority.

- .8 Rate of chlorine application to be proportional to rate of water entering pipe.
- .9 Chlorine application to be close to point of filling water main and to occur at same time.
- .10 Operate valves, hydrants and appurtenances while main contains chlorine solution.
- .11 Flush line to remove chlorine solution after 24 hours.
- .12 Measure chlorine residuals at extreme end of pipe-line being tested.
- .13 Perform bacteriological tests on water main, after chlorine solution has been flushed out.
 - 1. Take samples daily for minimum of 2 days.
 - 2. Should contamination remain or recur during this period, repeat disinfecting procedure.
 - 3. Specialist contractor to submit certified copy of test results.
- .14 Take water samples at sampling ports, in suitable sequence, to test for chlorine residual.
- .15 After adequate chlorine residual not less than 50 ppm has been obtained leave system charged with chlorine solution for 24 hours.
 - 1. After 24 hours, take further samples to ensure that there is still not less than 10 ppm of chlorine residual remaining throughout system.

3.18 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.
 - 1. Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 03 30 00 - Cast-in-Place Concrete.
- .2 Section 31 05 16 - Aggregate for Earthworks.
- .3 Section 31 23 33.01 – Excavating, Trenching and Backfilling.

1.2 REFERENCE STANDARDS

- .1 Departmental of Justice Canada (Jus)
 - .1 SOR/2018-196 Prohibition of Asbestos and Products Containing Asbestos Regulations.
- .2 ASTM International
 - .1 ASTM D 698-07e1, Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft⁴-lbf/ft² (600 kN-m/m²)).
 - .2 ASTM D 3034-08, Standard Specification for Type PSM Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings.
- .3 Underwriters Laboratory of Canada (ULC)
 - .1 CAN/ULC S701-11 Thermal Insulation, Polystyrene, Boards and Pipe Coverings
- .4 CSA International
 - .1 CSA A257 Series-M92(R2009), Standards for Concrete Pipe.
 - .2 CSA B1800-11, Thermoplastic Non-pressure Pipe Compendium.
 - .1 CSA B182.1-11, Plastic Drain and Sewer Pipe and Pipe Fittings.
 - .2 CSA B182.2-11, PSM Type Polyvinylchloride PVC Sewer Pipe and Fittings.
 - .3 CSA B182.11-11, Standard Practice for the Installation of Thermoplastic Drain, Storm, and Sewer Pipe and Fittings.
- .5 Ontario Provincial Standards Drawings (OPSD)
 - .1 OPSD 1006.010 Sewer Service Connections for Main Pipe Sewer.
 - .2 OPSD 1109.030 Insulation for Sewers and Watermains in Shallow Trenches
- .6 Ontario Provincial Standards Specifications (OPSS).
 - .1 OPSS.MUNI 410 Construction Specification for Pipe Sewer Installation in Open Cut
 - .2 OPSS.MUNI 1605 Extruded Expanded Polystyrene (EPS) Pavement Insulation
 - .3 OPSS.MUNI 1841 Material Specification for Non-Pressure Polyvinyl Chloride Pipe Products

1.3 ADMINISTRATIVE REQUIREMENTS

- .1 Scheduling:

- .1 Schedule Work to minimize interruptions to existing services and maintain existing sewage flows during construction.
- .2 Submit schedule of expected interruptions for approval and adhere to approved schedule.
- .3 Notify DCC Representative 48 hours minimum in advance of any interruption in service.

1.4 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 – Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for pipes and include product characteristics, performance criteria, physical size, finish and limitations.
 - .2 Pipe certification to be on pipe.
- .3 Test and Evaluation Reports:
 - .1 Submit manufacturer's test data and certification 4 weeks minimum before beginning Work.
 - .2 Submit to DCC Representative inspection and testing results and reports as described in PART 3 of this Section.

1.5 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with manufacturer's written instructions.
- .2 Storage and Handling Requirements:
 - .1 Store materials in accordance with manufacturer's recommendations.
 - .2 Store and protect pipes from damage.
 - .3 Replace defective or damaged materials with new, at no additional cost.

Part 2 Products

2.1 SERVICE CONNECTIONS

- .1 Type PSM Poly (Vinyl) Chloride: to CSA B182.2, OPSS Muni 1841.
 - .1 Pipe diameter as indicated
 - .2 Standard Dimensional Ratio (SDR): 28
 - .3 With push-on joints

2.2 PIPE BEDDING AND SURROUND MATERIALS

- .1 Granular material to Section 31 05 16 - Aggregate for Earthworks and following requirements:
 - .1 Granular A in accordance with OPSS Muni 1010

2.3 BACKFILL MATERIAL

- .1 Backfill material in accordance with Section 31 23 33.01 - Excavating, Trenching and Backfilling.

2.4 INSULATION

- .1 Polystyrene rigid insulation to the requirements of CAN/ULC S701: 50 mm thick, Class IV, with minimum Compressive Strength of 40psi (275kPa)

Part 3 Execution

3.1 PREPARATION

- .1 Clean pipes and fittings of debris and water before installation, and remove defective materials from site to approval of DCC Representative.
- .2 Clean and dry pipes and fittings before installation.
- .3 Obtain DCC Representative's approval of pipes and fittings prior to installation.

3.2 TRENCHING

- .1 Do trenching Work in accordance with Section 31 23 33.01 - Excavating, Trenching and Backfilling.
- .2 Protect trench from contents of sewer or sewer connection.
- .3 Trench alignment and depth require approval of DCC Representative prior to placing bedding material and pipe.

3.3 GRANULAR BEDDING

- .1 Place bedding in unfrozen condition.
- .2 Place granular bedding materials in uniform layers not exceeding 200 mm compacted thickness to depth of 150 mm below bottom of pipe.
- .3 Shape bed true to grade and to provide continuous, uniform bearing surface for pipe.
 - .1 Do not use blocks when bedding pipe.
- .4 Shape transverse depressions as required to suit joints.
- .5 Compact each layer full width of bed to at least 98% maximum density to ASTM D 698.
- .6 Fill excavation below bottom of specified bedding adjacent to maintenance holes or structures with compacted bedding material.

3.4 INSTALLATION

- .1 Lay and join pipes in accordance with manufacturer's recommendations and to approval of DCC Representative.
- .2 Handle pipe using methods approved by DCC Representative.
 - .1 Do not use chains or cables passed through rigid pipe bore so that weight of pipe bears upon pipe ends.

- .3 Lay pipes on prepared bed, true to line and grade, with pipe invert smooth and free of sags or high points.
 - .1 Ensure barrel of each pipe is in contact with shaped bed throughout its full length.
Tolerances: 5mm.
- .4 Begin laying at outlet and proceed in upstream direction with socket ends of pipe facing upgrade.
- .5 Joint deflection permitted within limits recommended by pipe manufacturer.
- .6 Do not allow water to flow through pipe during construction unless permitted by DCC Representative in writing.
- .7 Whenever Work is suspended, install removable watertight bulkhead at open end of last pipe laid to prevent entry of foreign materials.
- .8 Install plastic pipe and fittings in accordance with CSA B182.11.
- .9 Pipe jointing:
 - .1 Install gaskets in accordance with manufacturer's written recommendations.
 - .2 Support pipes with hand slings or crane as required to minimize lateral pressure on gasket and maintain concentricity until gasket is properly positioned.
 - .3 Align pipes before joining.
 - .4 Maintain pipe joints free from mud, silt, gravel and foreign material.
 - .5 Avoid displacing gasket or contaminating with dirt or foreign material. Gaskets so disturbed to be removed, cleaned and lubricated and replaced before joining is attempted.
 - .6 Complete each joint before laying next length of pipe.
 - .7 Minimize joint deflection after joint has been made to avoid joint damage.
 - .8 At rigid structures, install pipe joints not more than 1.2 m from side of structure.
 - .9 Apply sufficient pressure in making joints to ensure that joint is complete as outlined in manufacturer's recommendations.
- .10 When stoppage of Work occurs, block pipes as directed by DCC Representative to prevent creep during down time.
- .11 Cut pipes as required for special inserts, fittings or closure pieces as recommended by pipe manufacturer, without damaging pipe or its coating and to leave smooth end at right angles to axis of pipe.
- .12 Make watertight connections to maintenance holes.
 - .1 Use shrinkage compensating grout when suitable gaskets are not available.
- .13 Use prefabricated saddles or field connections approved by DCC Representative, for connecting pipes to existing sewer pipes.
 - .1 Joints to be structurally sound and watertight.
- .14 Insulate designated pipe sections as detailed on the drawings.
 - .1 Insulation installed over areas and in thickness indicated with OPSD 1109.030.

- .2 Sheets must be placed lengthwise and parallel to the centerline of the installation with staggered transverse joints. All sheets must be tightly battened together and secured to prevent movement.
- .3 Where insulation is to be installed on concrete surface, it must be secured in place with an approved adhesive.

3.5 PIPE SURROUND

- .1 Granular material to: Section 31 05 16 – Aggregates for Earthworks and the following requirements:
 - .1 Granular 'A' in accordance with OPSS.MUNI 1010
 - .2 The pipe bedding and cover material shall be Granular 'A' conforming to the dimensions in OPSD 802.010 or OPSD 802.013
- .2 Place surround material in unfrozen condition.
- .3 Upon completion of pipe laying, and after DCC Representative has inspected pipe joints, surround and cover pipes as indicated.
- .4 Hand place surround material in uniform layers not exceeding 200mm compacted thickness as indicated.
- .5 Place layers uniformly and simultaneously on each side of pipe.
- .6 Compact each layer to at least 98% corrected maximum dry density.
- .7 Cover material to extend to 300mm above top of pipe.

3.6 BACKFILL

- .1 Backfill material in accordance with Section 31 23 33.01 – Excavation, Trenching and Backfilling.
- .2 Place backfill material in unfrozen condition.
- .3 Place backfill material, above pipe surround in uniform layers not exceeding 300 mm compacted thickness up to grades as indicated.
- .4 Compact backfill to at least 98% maximum density to ASTM D 698.

3.7 SERVICE CONNECTIONS

- .1 Install pipe to CSA B182.11 and manufacturer's instructions and specifications.
- .2 Maintain grade for services at 1 vertical to 50 horizontal unless directed otherwise by DCC Representative.
- .3 Service connections to main sewer: standard Tee fittings DCC Representative approved saddles.
 - .1 Do not use break-in and mortar patch-type joints.
- .4 Service connection pipe: not to extend into interior of main sewer.

- .5 Make up required horizontal and vertical bends from 45 degrees bends or less, separated by straight section of pipe with minimum length of 4 pipe diameters.

- .1 Use long sweep bends where applicable.

3.8 FIELD TESTING

- .1 Repair or replace pipe, pipe joint or bedding found defective.
- .2 Remove foreign material from sewers and related appurtenances by flushing with water.
- .3 All deficiencies found shall be repaired by the Contractor.
- .4 All costs associated with field testing and repairs shall be borne by the Contractor.

3.9 QUALITY CONTROL

- .1 Contractor to complete quality control inspection and testing on the bedding and backfill in accordance with Section 31 23 33.01 - Excavating, Trenching and Backfilling.

3.10 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.
 - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.
- .3 Flush sewer pipes until CCTV inspections show no debris remains in pipes.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

- .1 Materials and installation for constructing subdrains complete with geotextile sock filter.

1.2 REFERENCES

- .1 OPSS Muni 1004 Material Specification for Aggregates - Miscellaneous.
- .2 OPSS 405 Construction Specification for Pipe Subdrains.
- .3 BNQ 3624-115- 2002-02-04, Polyethylene (PE) Pipe and Fittings-Flexible Corrugated Pipes for Drainage-Characteristics and Test Methods.
- .4 CAN/CGSB-8.1- 88, Sieves, Testing, Woven Wire, Inch Series.
- .5 CAN/CGSB-8.2- M88, Sieves, Testing, Woven Wire, Metric.

1.3 RELATED SECTIONS

- .1 Section 01 33 00 - Submittal Procedures.
- .2 Section 31 23 33.01 - Excavating Trenching and Backfilling.
- .3 Section 31 05 16 - Aggregate Materials.

1.4 SUBMITTALS

- .1 Submit samples in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Inform DCC Representative of proposed source of filter materials and provide access for sampling at least 10 business days near award.
- .3 Submit manufacturer's test data and certification that drain pipe materials meet requirements of this Section at least 10 business days near award.
- .4 Certification to be marked on pipe.

Part 2 Products

2.1 MATERIALS

- .1 Plastic pipe and fittings: to BNQ 3624-115, nominal inside diameter 150 mm.
- .2 Perforated polyethylene (PE) flexible corrugated pipe and fittings complete with manufacturer's recommended sockfilter. Nominal Pipe size 150 mm.
- .3 Bedding, cover and backfill shall be Mortar Sand conforming to OPSS 1004 Muni Table 6 and as detailed on the Contract drawings.

Part 3 Execution

3.1 TRENCHING

- .1 Do trenching and backfilling in accordance with Section 31 23 33.01 – Excavating, Trenching and Backfilling.
- .2 Place bedding material after approval of trench by DCC Representative.

3.2 BEDDING

- .1 Place 50 mm layer of bedding material to full trench width as per Contract drawings and compact to minimum 95% of maximum density to ASTM D698.

3.3 INSTALLATION OF PIPE SUBDRAINS

- .1 Lay pipe drains on prepared bed, true to line and grade with inverts smooth and free of sags or high points.
 - .1 Ensure barrel of each pipe is in contact with bed throughout full length.
- .2 Begin laying at outlet and proceed in upstream direction.
- .3 Lay perforated pipes with perforations downwards at 4 o'clock and 8 o'clock positions.
- .4 Lay bell and spigot pipe with bell ends facing upstream.
 - .1 Do not mortar joints.
- .5 All connections to manholes and catch basins shall be cored and grouted.
- .6 Make joints tight in accordance with manufacturer's instructions.
- .7 Make watertight connections to existing drains, new or existing manholes and catch basins where indicated or as directed by DCC Representative.
- .8 Plug open upstream ends of pipes with watertight manufactured caps.
- .9 Surround and cover drain with filter material in uniform layers and compact to at least 95% of corrected maximum dry density.
- .10 Backfill remainder of trench to Section 31 23 33.01 – Excavating, Trenching and Backfilling.
- .11 Do not place bedding surround and backfill materials in frozen condition.
- .12 Protect subdrains against flotation during installation.

3.4 CONNECTIONS TO SEWER FACILITIES

- .1 Connect pipe subdrains to storm sewer system as detailed on the Contract drawings.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 01 33 00 - Submittal Procedures.
- .2 Section 01 45 00 - Quality Control.
- .3 Section 01 74 11 - Cleaning.

1.2 REFERENCES

- .1 American Society for Testing and Materials International (ASTM)
 - .1 ASTM A 82-02/A 82M-07, Standard Specification for Steel Wire, Plain, for Concrete Reinforcement.
 - .2 ASTM A 185-02/A 185M-06e1a, Standard Specification for Steel Welded Wire Reinforcement, Plain, for Concrete.
 - .3 ASTM C 139-17, Standard Specification for Concrete Masonry Units for Construction of Catch Basins and Manholes.
 - .4 ASTM C 478/C 478M-22, Standard Specification for Precast Reinforced Concrete Manhole Sections.
 - .5 ASTM D 1056-20, Standard Specification for Flexible Cellular Materials - Sponge or Expanded Rubber.
- .2 Canadian Standards Association (CSA International)
 - .1 CAN/CSA-A3000-18, Cementitious Materials Compendium (Consists of A3001, A3002, A3003, A3004 and A3005).
 - .2 CSA A23.1-19/A23.2-19, Concrete Materials and Methods of Concrete Construction/Methods of Test and Standard Practices for Concrete.
 - .3 CAN/CSA-G30.18-21, Carbon Steel Bars for Concrete Reinforcement.
- .3 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
 - .1 Material Safety Data Sheets (MSDS).

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's printed product literature, specifications and datasheet and include product characteristics, performance criteria, physical size, finish and limitations.
 - .2 Submit WHMIS MSDS - Material Safety Data Sheets.
- .3 Shop Drawings:
 - .1 Submit shop drawings for precast manholes.

- .4 Quality assurance submittals: submit following in accordance with Section 01 45 00 - Quality Control.
 - .1 Test reports: submit certified test reports for specified materials from approved independent testing laboratories, indicating compliance with specifications for specified performance characteristics and physical properties.
 - .2 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
- .5 Manufacturer's Instructions: submit manufacturer's installation instructions and special handling criteria, installation sequence, cleaning procedures.

1.4 DELIVERY, STORAGE AND HANDLING

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

Part 2 Products

2.1 PVC DUCTS

- .1 PVC ducts, type EB1, encased in reinforced concrete.

2.2 PVC DUCT FITTINGS

- .1 Rigid PVC opaque solvent welded type couplings, bell end fittings, plugs, caps, adaptors as required to make complete installation.
- .2 Expansion joints.
- .3 Rigid PVC 5 degree angle couplings.

2.3 MANHOLES

- .1 Provide type indicated.
- .2 Top, walls, and bottom: reinforced concrete.
- .3 Walls and bottom: monolithic concrete construction.
- .4 Locate duct entrances and windows near corners of structures to facilitate cable racking.
- .5 Covers: fit frames without play.
- .6 Form steel and iron to shape and size with sharp lines and angles.
- .7 Castings: warp and blow hole free.

- .8 Exposed metal: smooth finish without sharp lines and arises.
- .9 Provide lugs, rabbets, and brackets.
- .10 Set pulling-in irons and other built-in items in place before depositing concrete.
- .11 Install pulling-in iron in wall opposite each duct line entrance.
- .12 Cable racks, including rack arms and insulators: sized to accommodate cable.

2.4 PRECAST CONCRETE MANHOLES

- .1 Precast concrete manholes and auxiliary sections fabricated in steel forms.
- .2 Aggregates: to CSA A23.1/A23.2.
- .3 Cement: CAN/CSA-A3000, Type GU.
- .4 Pulling inserts and bolts for racks integrally cast in concrete.
- .5 Neoprene gasket seals between manhole sections: to ASTM D 1056.
- .6 Size: 762 mm clear diameter.
- .7 Precast Concrete Manholes: to ASTM C 478/C 478M.
 - .1 Manhole step and ladder rung spacing: 405.

2.5 CAST-IN-PLACE CONCRETE MANHOLES

- .1 Smooth trowel finish for floors and horizontal surfaces.
- .2 Concrete: in accordance with Section 03 30 00 - Cast-in-Place Concrete
- .3 Construct walls on cast-in-place concrete footing except that precast concrete base sections are used for precast concrete manhole risers.
- .4 Concrete block: to ASTM C 139.

2.6 DRAINAGE

- .1 Floor drain fittings: consisting of floor drain, back water valve, trap and pipe connection to drainage system.
- .2 Storm sewer connection: cast iron service saddle consisting of oil resistant gasket, stainless steel clamp and oil resistant O ring.
- .3 Sump pit: 300 x 300 x 125 mm.

2.7 MANHOLE NECKS

- .1 Concrete brick and mortar.

2.8 MANHOLE FRAMES AND COVERS

- .1 Cast iron manhole frames and covers.
- .2 Bolted on covers to prevent unauthorized entry.
- .3 Size: 762 mm clear diameter.

2.9 GROUNDING

- .1 Ground rods: in accordance with Section 26 05 28 Grounding-Secondary.

2.10 CABLE RACKS

- .1 Hot dipped galvanized cable racks and supports.
- .2 12 x 100 mm preset inserts for rack mounting.

2.11 CABLE PULLING EQUIPMENT

- .1 Pulling iron: galvanized steel rods, size and shape as indicated.
- .2 Pull rope: 3 mm stranded polypropylene, tensile strength 5 kN, continuous throughout each duct run with 3 m spare rope at each end.

2.12 MARKERS

- .1 Concrete type cable markers: 600 x 600 x 100 mm, with words: "Cable", "Joint", "Conduit" impressed in top surface, with arrows to indicate change in direction of duct runs.

Part 3 Execution

3.1 MANUFACTURER'S INSTRUCTIONS

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

3.2 INSTALLATION GENERAL

- .1 Install underground duct banks and manholes including formwork.
- .2 Build duct bank and manholes on undisturbed soil or on well compacted granular fill not less than 150 mm thick, compacted to 95% of maximum proctor dry density.
- .3 Open trench completely between manholes before ducts are laid and ensure that no obstructions will necessitate change in grade of ducts.
- .4 Install ducts at elevations and with slope as indicated and minimum slope of 1 to 400.
- .5 Install base spacers at maximum intervals of 1.5 m levelled to grades indicated for bottom layer of ducts.

- .6 Lay PVC ducts with configuration and reinforcing as indicated with preformed interlocking, rigid plastic intermediate spacers to maintain spacing between ducts at not less than 75 mm horizontally and vertically.
 - .1 Stagger joints in adjacent layers at least 150 mm and make joints watertight.
 - .2 Encase duct bank with 75 mm thick concrete cover.
- .7 Make transpositions, offsets and changes in direction using 5 degree bend sections, do not exceed a total of 20 degree with duct offset.
- .8 Use bell ends at duct terminations in manholes or buildings.
- .9 Use conduit to duct adapters when connecting to conduits.
- .10 Terminate duct runs with duct coupling set flush with end of concrete envelope when dead ending duct bank for future extension.
- .11 Cut, ream and taper ends of ducts in field in accordance with manufacturer's recommendations, so that duct ends are fully equal to factory-made ends.
- .12 Allow concrete to attain 50% of its specified strength before backfilling.
- .13 Use anchors, ties and trench jacks as required to secure ducts and prevent moving during placing of concrete.
 - .1 Tie ducts to spacers with twine or other non-metallic material.
 - .2 Remove weights or wood braces before concrete has set and fill voids.
- .14 Clean ducts before laying:
 - .1 Cap ends of ducts during construction and after installation to prevent entrance of foreign materials.
- .15 Duct cleaning:
 - .1 Pull 300 mm long x diameter 6 mm less than internal diameter of duct wooden mandrel through each duct, immediately after placing of concrete.
 - .2 Then pull stiff bristle brush through duct; avoid disturbing or damaging ducts where concrete has not set completely.
 - .3 Pull stiff bristle brush through each duct immediately before pulling-in cables.
- .16 Install four 3 m lengths of 15M reinforcing rods, one in each corner of duct bank when connecting duct to manholes or buildings.
 - .1 Wire rods to 15M dowels at manhole or building and support from duct spacers.
 - .2 Protect existing cables and equipment when breaking into existing manholes.
 - .3 Place concrete down sides of duct bank filling space under and around ducts.
 - .4 Rod concrete with flat bar between vertical rows filling voids.
- .17 Install pull rope continuous throughout each duct run with 3 m spare rope at each end.

3.3 MANHOLES

- .1 Install precast manholes.

- .2 Concrete Placement:
 - .1 Place concrete in two lifts with slab and sump in first, walls, roof and neck in second lift.
 - .2 Provide key in walls to slab.
 - .3 Place 100 x 6 mm PVC water bar vertically in key.
 - .4 Install ground rod before placing slab and place reinforcing steel, inserts for cable rack, pulling irons, drain, duct outlets, duct run dowels before casting walls. Make manhole to duct connection as indicated.
- .3 Provide 115 mm deep window to facilitate cable bends in wall at each duct connection.
 - .1 Terminate ducts in bell-end fitting flush with window face.
 - .2 Provide four 10M steel dowels at each duct run connection to anchor duct run.
- .4 Alternately connect large duct runs by leaving square opening in wall, later pouring duct run and wall opening in one pour and install 10M x 3m reinforcing rods in duct run at manhole connection.
- .5 Build up concrete manhole neck to bring cover flush with finished grade in paved areas and 40 mm above grade in unpaved areas.
- .6 Install manhole frames and covers for each manhole:
 - .1 Set frames in concrete grout onto manhole neck.
- .7 Drain floor towards sump with 1 to 48 slope minimum and install drainage fittings as indicated.
- .8 Install cable racks, anchor bolts and pulling irons as indicated.
- .9 Grout frames of manholes:
 - .1 Cement grout to consist of two parts sand and one part cement and sufficient water to form a plastic slurry.
- .10 Ensure filling of voids in joint being sealed.
 - .1 Plaster with cement grout, walls, ceiling and neck.
- .11 Spray paint "X" on ceiling of manhole above floor drain or sump pit.

3.4 MARKERS

- .1 Mark location of duct runs under hard surfaced areas not terminating in manhole with railway spike driven flush in edge of pavement, directly over run.
 - .1 Place concrete duct marker at ends of such duct runs.
 - .2 Construct markers and install flush with grade.
- .2 Mark ducts every 50 m along straight runs and changes in direction.
- .3 Where markers are removed to permit installation of additional duct, reinstall existing markers.
- .4 Lay concrete markers flat and centered over duct with top 25 mm above earth surface.
- .5 Provide drawings showing locations of markers.

3.5 FIELD QUALITY CONTROL

- .1 Site Tests/Inspections:
 - .1 Inspection of duct will be carried out by DCC Representative prior to placing.
 - .2 Placement of concrete and duct cleanout to be done when DCC Representative present.

3.6 CLEANING

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

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

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

Part 2 Products

2.1 PVC DUCTS AND FITTINGS

- .1 Rigid PVC ducts type DB2 for direct burial: with minimum wall thickness as listed below:

Duct Size	Wall Thickness
19 mm	2.87 mm
25 mm	3.38 mm
32 mm	3.56 mm
38 mm	3.68 mm
50 mm	3.91 mm
75 mm	5.49 mm
100 mm	6.02 mm

- .2 Rigid PVC ducts type DB2 split ducts.
- .3 Rigid PVC ducts type DB2 couplings, reducers, bell end fittings, plugs, caps, adaptors as required to make complete installation.
- .4 Rigid PVC ducts type DB2, 90 and 45 degree bends as required.
- .5 Rigid PVC ducts type DB2, 5 degree angle couplings as required.
- .6 Expansion joints as required.

2.2 SOLVENT WELD COMPOUND

- .1 Solvent weld compound for Rigid PVC duct joints.

2.3 CABLE PULLING EQUIPMENT

- .1 6 mm stranded nylon pull rope tensile strength 180 kN.

2.4 WARNING TAPE

- .1 Plastic, red coloured with black lettering, to run entire length of duct bank and to be full width of trench.

Part 3 Execution

3.1 INSTALLATION - DUCTS

- .1 Install direct buried ducts according to drawings and specifications.
- .2 Open trench completely before ducts are laid and ensure that no obstructions will necessitate change in grade of ducts.

- .3 For sections of the ducts across building foundations and underneath buildings, use galvanized rigid steel conduits in lieu of rigid PVC ducts. Bond the steel conduits in the duct bank and connect to the ground grid at the point of entry below the building. Minimum bonding and ground wire size to be #1/0. Use conduit to duct adapters when connecting to conduits.
- .4 Clean ducts before laying. Cap ends of ducts during construction and after installation to prevent entrance of foreign materials.
- .5 Immediately after the ducts are in place, pull through each conduit/duct steel wooden mandrel not less than 300 mm long and of diameter 6 mm less than internal diameter of duct, followed by stiff bristle brush to remove sand, earth and other foreign matter. Pull stiff bristle brush through each duct immediately before pulling-in-cables.
- .6 In each duct install pull rope continuous throughout each duct run with 3.0 m spare rope at each end.
- .7 Minimum of 1.0 m cover on ducts.

3.2 INSTALLATION – WARNING TAPE

- .1 Provide continuous run of warning tape above ducts at 150 to 300 mm below finished grade for full width and length of trench.

END OF SECTION

8 Wing Procedures for New Watermains

(Or other maintenance s as designated)

Version 1 Rev 0 April 2016 VW

1. INTRODUCTION

This document is to provide guidance and standardized procedures for installation and commissioning of newly installed mains and services for potable water 38mm (1.5”) and larger for 8 Wing Trenton and satellite facilities, these procedures may be required for some maintenance activities as designated by the ORO, they will cover the cleaning, disinfection, hydrostatic testing and sampling, services smaller than 38mm will be dealt with on an individual basis. Unless specified otherwise this procedure applies to all new watermains and includes above ground bypass or temporary services. 8 Wing will not provide reference material other than what is included in this document it is the responsibility of the contractor to be knowledgeable of legislation and procedures involved with the installation or maintenance contract if clarification is required WFE will provide guidance to DCC and the contractor for situations where standards would be difficult or expensive to be applicable.

2. DEFINITIONS

Owner – DND 8 Wing Trenton.

WFE – 8 Wing Water Fuel Environmental Services.

ORO – Overall Responsible Operator

Project Engineer - shall be designated by the Owner, and could be a Consulting Engineer, or their designate.

Operator – Can be a contractor whose personnel hold valid certification as Water Distribution Subsystem Class 1 Operator (minimum) under Ontario Regulation 128/04 or any other person who holds a Non Restricted Water Treatment, Water Distribution or Water Quality Analyst certification for the Province of Ontario or equivalent. **Ontario Reg128//04 states or a “trained person” but does not define what a trained person is so 8 Wing requires certified operators or DND Pre Med Tech to collect and analyse samples for potable water**

AWWA - American Water Works Association.

NSF – National Sanitation Foundation.

WTD3 - AWWA “Water Transmission and Distribution Third Edition”

EC, TC, HPC – Esoterica Coliform, Fecal Coliform, Heterotrophic Plate Count.

MOE – Ontario Ministry of the Environment.

Watermain Flushing – The conveyance of potable water through a watermain at the AWWA specified volumes, velocities and time until the discharge water is similar in analysis for turbidity and free chlorine residual as the source water.

Pressure Test – The application of positive hydraulic pressure to a watermain and fittings for a predetermined pressure and time that meets or exceeds all applicable AWWA standards for such pressure testing and allowable leakage.

Disinfection of Mains – A watermain that has been installed pressure tested, flushed and or swabbed and has had a disinfection solution at a **minimum** of 25mg/L free chlorine residual in contact with the main for 24hrs. If there is more than a 15% reduction between the applied chlorine residual and the 24hr contact time chlorine residual the main will need to be flushed and re chlorinated until it meets less than the 15% chlorine demand in a 24hr period. **Any portions of the main or fittings that will not be in contact with the disinfection solution shall be swabbed with a minimum of 5% NSF chlorine solution prior to installation**.

3. REFERENCES

References made within this document are based on current documentation and may be modified as legislation or reference material is updated. Documents include AWWA “Water Transmission and Distribution Third Edition”, Ontario MOE specifications and guides, Ontario Safe Drinking Water Act 2002 and its supporting Regulations, AWWA Cross Connection and Backflow Standards, AWWA “Disinfecting Watermains (June 2005), 10 State Standards and others. Procedures may be modified for specific installations with authorization from 8 Wing WFE management or the designated ORO.

4. NOTIFICATION

WFE will be given written notification of any new watermain installation or maintenance projects 15 working days prior to commencement of the project, notification will include plans, procedures and timings for the contract. The contractor is to provide specific procedures for the connection to the potable water system. If a meeting is required regarding issues with the proposal it will be conducted prior to commencement of the work. The ORO or their designate is the only person authorised to allow connections to the potable water system for 8 Wing. All required documentation will be provided to the contractor with the bid proposal or prior to the start of the installation.

5. SUPERVISION, TESTING, AND RECORDS

The Project Engineer, their designate and or a certified operator shall witness all cleaning, disinfection, hydrostatic testing and sampling activities. The workforce carrying out the cleaning and disinfection are required to document all information/data on the included forms in an indelible medium and be legible, upon completion such records shall be submitted to the owner forthwith. Any other pertinent information shall be documented on separate sheets and included with the forms. For projects that involve WFE staff the included form “ANNEX A” will be completed and submitted with supporting documentation to WFE management for records.

6. ISOLATION VALVE OPERATION / TEMPORARY CONNECTIONS

Any valve that is directly connected to the owner’s distribution system shall be operated only by the 8 Wing Plumbing shop with WFE knowledge. A temporary connection may be utilized to charge and flush the main from an existing service provided a viable (valid test certificate) backflow preventer is installed at the service point; this will need to be isolated prior to pressure testing.

7. INSTALLATION OF NEW WATERMAIN / SERVICE

Watermain shall be handled stored and installed in accordance with the WTD3, Ontario Standards or as specified by the Project Engineer. The installed main shall not be activated until all approvals, procedures, tests and documentation have been completed. Procedures include but are not limited to charging, air elimination, pressure / leakage testing, swabbing, disinfection, bacteriological, chlorine residuals, pH and turbidity.

8. PHYSICAL, CHEMICAL and BACTERIOLOGICAL TESTS

All compliance sampling and analytical tests must be completed by a person holding an unrestricted Ontario Water Treatment/Distribution certification level 1 (one) or greater, an Ontario Water Quality Analyst certificate or a certified Laboratory Technician. Upon successful completion of the physical testing and disinfection procedures, the main is to be flushed with distribution system water until the turbidity and chlorine residuals are comparable with source

water 2 (two) bacteriological samples need to be collected 24 hours apart and analysed at a MOE certified laboratory for EC, TC and HPC, negative results will allow the main to be activated * The contractor is responsible for costs of the analysis* The contractor may conduct their own analytical testing for installation purposes but the data will not be used for compliance purposes. Analytical equipment used will be documented on the commissioning form.

9. CHEMICALS in CONTACT WITH MATERIAL and WATER

All chemicals or substances that may be in contact with the material and potable water will be approved for such contact. Disinfectant will be Calcium or Sodium Hypochlorite that meets or exceeds ANSI/AWWA/NSF Standards for Potable Water, if calcium hypochlorite is used the solution shall be made up with "POTABLE WATER". Neutralizing Agent will be Sodium Thiosulfate that meets or exceeds AWWA/NSF standards.

10. DISCHARGE of DISINFECTION SOLUTION

The disinfection solution may be discharged into the sanitary sewer (with permission from WFE) or into the storm system, the solution **must be dechlorinated** to less than 5mg/L with Sodium Thiosulfate prior to entering the storm or possibly the sanitary system dependant on volume and concentration.

11. SAMPLE SCOPE of WORK

Main installed and connected by direct tap or temporary connection.

Swabbing, air expulsion, and filling of main with potable water until turbidity and chlorine residuals match source.

Pressure testing of main document test of pressure test results, disinfection can be done at this time or as a second step at the contractor's discretion.

Disinfection for 24hrs of main with solution.

Flushing of main, testing for compatibility with source water, acquire 1st bacteriological sample and chlorine residual, 24 hrs later collect 2nd bacteriological sample and chlorine residual.

If bacterial results are negative place main in service.

NOTE if main was connected with a temporary service, the temporary service will need to be replaced with disinfected cut in components and flushed in accordance with AWWA standards prior to entering service no water or debris will be allowed to enter the main during cut in procedure.

Click on the Adobe Icon below for a copy of the AWWA Standard for Disinfection of Watermains.



Adobe Acrobat
Document

ANNEX “A”
8WING TRENTON WATERMAIN COMMISSIONING FORM

Contacts

EMERGENCIES Wing Fire Hall 392 2811 x 3511

WFE

Supervisor - Bill Haddock 392 2811 x 7498, C – 848 4584 william.haddock@forces.gc.ca

Assistant Supervisor (ORO) – Vern Woodbeck 392 2811 x 2198, C 922 1239
vernon.woodbeck@forces.gc.ca

General Contact WPCP Duty Operator 392 2811 x 3118

CE Plumbing Shop Contact

Supervisor – Fred Carmichael 392 2811 x 2913 FRED.CARMICHAEL@forces.gc.ca

PROJECT ID / DESCRIPTION _____

LOCATION _____

DATE (DD/MM/YYYY) _____

CONTRACTOR _____

CONTRACTOR CONTACT(S)

Name

Phone

DIRECT CONNECTION or TEMPORARY BYPASS

(Circle Applicable)

PESSURE TEST - DATE _____

PASS

FAIL

(DD/MM/YYYY)

Attach Supporting Documentation

Disinfection Solution Results

(Collect at end of installation)

Primary

Date (DD-MM-YY) _____

Free Chlorine Residual mg/L

(minimum 25) _____ Operator _____

Analytical Instrument _____

Secondary (24 hrs after Primary)

Date (DD-MM-YY) _____

Free Chlorine Residual mg/L (Secondary residual must not be less than 15% of Primary

sample) _____ Operator _____

Flushing Results and Bacteriological Sampling

(End of installation analysis shall be similar to source)

Date (DD-MM-YY) _____

Source Sample

Chlorine Residual mg/L Free _____ Total _____

Analytical Instrument _____

Turbidity FTU _____ or NTU _____

Analytical Instrument _____

End of Installation

Chlorine Residual mg/L Free _____ Total _____

Turbidity FTU _____ or NTU _____

Flushing PASS FAIL

First Bacterial sample collected YES NO

Bacterial Sample (Attach Results) PASS FAIL

Operator _____

Second Bacterial sample collected YES NO

Bacterial Sample (Attach Results) PASS FAIL

Operator _____

System Activation Approval

Installation is approved for activation

WFE Supervisor

Print Name
Date (DD-MM-YY)_____

Signature

Plumbing Shop Valve Opening

Date (DD-MM-YY)_____

Plumber Initials

Attached Document List:

COMMENTS / NOTES: