

ECCC PROJECT NO. CCIW-079

SPECIFICATION

CCIW - 867 LAKESHORE ROAD, BURLINGTON BOILER ROOM - SANITARY PIT REFURBISHMENT

JULY 9, 2019

VERSION: ISSUE FOR TENDER



PREPARED FOR:
CANADA CENTRE FOR INLAND WATERS (CCIW)
867 LAKESHORE ROAD
BURLINGTON, ON L7S 1A1
ATTN: ROD KHALED

MAY 2019
BOILER ROOM - SANITARY PIT REFURBISHMENT
ECCC PROJECT NO: CCIW-079

Section 00 00 00
SPECIFICATION TITLE SHEET
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PROJECT TITLE: Canadian Centre for Inland Waters (CCIW)
Boiler Room - Sanitary Pit Refurbishment
867 Lakeshore Road, Burlington, On L7S 1A1

PROJECT NUMBER: ECCC PROJECT NO: CCIW-079

PROJECT DATE: 2019 07 09

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END OF SECTION

PART 1. GENERAL

1.1 RELATED REQUIREMENTS

- .1 Section 02 41 00 Hydrodemolition
- .2 Section 03 20 00 Concrete Reinforcing
- .3 Section 03 30 00 Cast-in-Place Concrete
- .4 Section 05 10 00 Structural Metal Framing
- .5 Section 05 50 00 Metal Fabrication
- .6 Section 20 04 00 Mechanical General Provisions
- .7 Section 20 05 00 Basic Mechanical Materials and Methods
- .8 Section 20 08 00 Commissioning
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- .20 Section 26 05 34 Conduit Systems
- .21 Section 26 27 26 Wiring Devices
- .22 Section 26 28 23 Disconnect Switches

1.2 OBJECTIVE

- .1 The objective of the work under this contract is to:
 - a. refurbish the existing boiler room sump pits
 - b. replace the existing pumping provisions including power provisions and controls
 - c. replace the local piping from the pits to the wall penetration
 - d. replace the metal access stair
 - e. pressure wash and clean the area surrounding the sump pits

- f. provide a new floor topping for the entire area around the pits, beneath the new stair, and up to the service tunnel entrance.

1.3 PHASING

- .1 The work is to be completed in two phases and maintain sanitary service.
 - a. Phase one will isolate sump pit 'A' for refurbishment as shown on drawing M-200.
 - b. Phase two will isolate sump pit 'B' for refurbishment as shown on drawing M-201.
 - c. Demolition, concrete work, metal work, mechanical work, controls work and electrical work to be coordinated with the phasing.
 - d. Backup pumping provisions are to be provided in the event of a pump failure during construction.

PART 2 PRODUCTS – NOT USED - SEE DRAWINGS AND RELATED REQUIREMENTS

PART 3 EXECUTION – NOT USED- SEE DRAWINGS AND RELATED REQUIREMENTS

END OF SECTION

PART 1 GENERAL

1.1 RELATED REQUIREMENTS

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- .22 Section 26 28 23 Disconnect Switches

1.2 ACCESS AND EGRESS

- .1 Design, construct and maintain temporary "access to" and "egress from" work areas, including stairs, runways, ramps or ladders, 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 Departmental Representative to facilitate work as stated.
- .2 Maintain existing services to building and provide for personnel and vehicle access.

- .3 Where security is reduced by work provide temporary means to maintain security.
- .4 Contractor shall provide and maintain temporary sanitary facilities for their own use for the project duration. Keep facilities clean.
- .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 building operations and normal use of premises. Arrange with Departmental Representative to facilitate execution of work.

1.5 EXISTING SERVICES

- .1 Notify, Departmental Representative of intended interruption of services and durations and obtain required permission.
- .2 Where Work involves breaking into or connecting to existing services, give Departmental Representative 48 hours of notice for necessary interruption of mechanical or electrical service throughout course of work. Keep duration of interruptions minimum. Carry out interruptions after normal working hours of occupants, preferably on weekends.
- .3 Access into and out of the building shall not be restricted by the work. Provide temporary protections where required to maintain building access.
- .4 Construct barriers in accordance with Section 01 56 00 - Temporary Barriers and Enclosures.

1.6 SPECIAL REQUIREMENTS

- .1 Submit schedule in accordance with Section 01 32 16.19 - Construction Progress Schedule - Bar (GANTT) Chart.
- .2 Ensure Contractor's personnel employed on site become familiar with and obey regulations including safety, fire, traffic and security regulations.
- .3 Keep within limits of work and avenues of ingress and egress.

1.7 SECURITY

- .1 Where security has been reduced by Work of Contract, provide temporary means to maintain security.
- .2 Security clearances:
 - .1 Personnel employed on this project will be subject to security check. Obtain clearance, as instructed, for each individual who will require to enter premises.
 - .2 Obtain requisite clearance, as instructed, for each individual required to enter premises.
- .3 Site Access: Normal working hours 7.00am to 6.00pm.
 - .1 Contractor superintendent shall be present at all times during construction, escort individuals to site and be responsible for all employees' access. Contractor superintendent will be provided with

an access card after reliability check performed by PWGSC/EC. All contractor employees shall sign-in and out daily at security desk.

- .2 Contractor may work after hours only with pre-arrangement with Departmental Representative. Owners site representative will be required, and security deployed for all after hours work.

1.8 BUILDING SMOKING ENVIRONMENT

- .1 Comply with smoking restrictions.
- Smoking is not permitted.

PART 2 PRODUCTS – NOT USED

PART 3 EXECUTION – NOT USED

END OF SECTION

PART 1 GENERAL

1.1 CASH ALLOWANCES

- .1 Include in Contract Price specified cash allowances.
- .2 Cash allowances, unless otherwise specified, cover net cost to Contractor of services, products, construction machinery and equipment, freight, handling, unloading, storage installation and other authorized expenses incurred in performing Work.
- .3 Contract Price, and not cash allowance, includes Contractor's overhead and profit in connection with such cash allowance.
- .4 Contract Price will be adjusted by written order to provide for excess or deficit to each cash allowance.
- .5 Where costs under a cash allowance exceed amount of allowance, Contractor will be compensated for excess incurred and substantiated plus allowance for overhead and profit as set out in Contract Documents.
- .6 Include progress payments on accounts of work authorized under cash allowances in Consultant's monthly certificate for payment.
- .7 Prepare schedule jointly with Departmental Representative, Consultant and Contractor to show when items called for under cash allowances must be authorized by Consultant for ordering purposes so that progress of Work will not be delayed.
- .8 Amount of each allowance, for Work specified in respective specification Sections is as follows:
 - .1 There are no cash allowances included for this work.

PART 2 PRODUCTS – NOT USED

PART 3 EXECUTION – NOT USED

END OF SECTION

PART 1 GENERAL

1.1 ADMINISTRATIVE

- .1 Schedule and administer project meetings throughout the progress of the work at the call of Departmental Representative.
- .2 Prepare agenda for meetings.
- .3 Distribute written notice of each meeting four days in advance of meeting date to Consultant and Departmental Representative.
- .4 Provide physical space and make arrangements for meetings.
- .5 Preside at meetings.
- .6 Record the meeting minutes. Include significant proceedings and decisions. Identify actions by parties.
- .7 Reproduce and distribute copies of minutes within three days after meetings and transmit to meeting participants, Departmental Representative, affected parties not in attendance, and Consultant.
- .8 Representative of Contractor, Subcontractor and suppliers attending meetings will be qualified and authorized to act on behalf of party each represents.

1.2 PRECONSTRUCTION MEETING

- .1 Within 15 days after award of Contract, request a meeting of parties in contract to discuss and resolve administrative procedures and responsibilities.
- .2 Consultant, Departmental Representative, Contractor, major Subcontractors, field inspectors, and supervisors will be in attendance.
- .3 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 Schedules - Bar (GANTT) Chart.
 - .3 Schedule of submission of shop drawings, samples, colour chips. Submit submittals in accordance with Section 01 33 00 - Submittal Procedures.
 - .4 Requirements for temporary facilities, site sign, offices, storage sheds, utilities, fences in accordance with Section 01 52 00 - Construction Facilities.
 - .5 Delivery schedule of equipment and materials.
 - .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 Owner provided products.
- .9 Record drawings in accordance with Section 01 33 00 - Submittal Procedures.
- .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.
- .14 Progress meeting schedule.

1.3 PROGRESS MEETINGS

- .1 During course of Work schedule progress meetings as agreed in 1.2.5 above.
- .2 Contractor, major Subcontractors involved in Work, Consultant and Departmental Representative are to be in attendance.
- .3 Notify parties minimum five days prior to meetings.
- .4 Record minutes of meetings and circulate to attending parties and affected parties not in attendance within three days after meeting.
- .5 Agenda to include the following:
 - .1 Review, approval of minutes of previous meeting.
 - .2 Review of Work progress since previous meeting.
 - .3 Field observations, problems, conflicts.
 - .4 Problems which impede construction schedule.
 - .5 Review of off-site fabrication delivery schedules.
 - .6 Corrective measures and procedures to regain projected schedule.
 - .7 Revision to construction schedule.
 - .8 Progress schedule, during succeeding work period.
 - .9 Review submittal schedules: expedite as required.
 - .10 Maintenance of quality standards.
 - .11 Review proposed changes for effect on construction schedule and on completion date.
 - .12 Other business.

PART 2 PRODUCTS – NOT USED

PART 3 EXECUTION – NOT USED

END OF SECTION

PART 1 GENERAL

1.1 RELATED REQUIREMENTS

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1.2 DEFINITIONS

- .1 Activity: element of Work performed during course of Project. Activity normally has expected duration and expected cost and expected resource requirements. Activities can be subdivided into tasks.
- .2 Bar Chart (GANTT Chart): graphic display of schedule-related information. In typical bar chart, activities or other Project elements are listed down left side of chart, dates are shown across top, and activity durations are shown as date-placed horizontal bars. Generally, Bar Chart should be derived from commercially available computerized project management system.

- .3 Baseline: original approved plan (for project, work package, or activity), plus or minus approved scope changes.
- .4 Construction 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 activity or other project element. Usually expressed as workdays or workweeks.
- .6 Master Plan: summary-level schedule that identifies major activities and key milestones.
- .7 Milestone: significant event in project, usually completion of major deliverable.
- .8 Project Schedule: planned dates for performing activities and the planned dates for meeting milestones. Dynamic, detailed record of tasks or activities that must be accomplished to satisfy Project objectives. Monitoring and control process involves using Project Schedule in executing and controlling activities and is used as basis for decision making throughout project life cycle.
- .9 Project Planning, Monitoring and Control System: overall system operated by Departmental Representative to enable monitoring of project work in relation to established milestones.

1.3 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.

1.4 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00- Submittal Procedures.
- .2 Submit Project Schedule to Departmental Representative within 5 working days of receipt of acceptance of Master Plan.

1.5 MASTER PLAN

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

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- .4 Accepted revised schedule will become Master Plan and be used as baseline for updates.

1.6 PROJECT SCHEDULE

- .1 Develop detailed Project Schedule derived from Master Plan.
- .2 Ensure detailed Project Schedule includes as minimum activity types as follows:
 - .1 Award.
 - .2 Shop Drawings, Samples.
 - .3 Permits.
 - .4 Mobilization.
 - .5 Phase One Activities.
 - .6 Phase Two Activities.
 - .7 Sheet Metal Installation.
 - .8 Electrical Shut Downs.
 - .9 Mechanical Shut Downs.
 - .10 Close-out.

1.7 CT SCHEDULE REPORTING

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

1.8 PROJECT MEETINGS

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

PART 2 PRODUCTS – NOT USED

PART 3 EXECUTION – NOT USED

END OF SECTION

PART 1 GENERAL

1.1 ADMINISTRATIVE

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

1.2 SHOP DRAWINGS AND PRODUCT DATA

- .1 The term "shop drawings" means drawings, diagrams, illustrations, schedules, performance charts, brochures and other data which are to be provided by Contractor to illustrate details of a portion of Work.
- .2 Submit drawings stamped and signed by professional engineer registered or licensed in the Province of Ontario, Canada.
- .3 Indicate materials, methods of construction and attachment or anchorage, erection diagrams, connections, explanatory notes and other information necessary for completion of Work. Where articles or equipment attach or connect to other articles or equipment, indicate that such items have been coordinated, regardless of Section under which adjacent items will be supplied and installed. Indicate cross references to design drawings and specifications.
- .4 Allow 5 days for Consultant and Departmental Representative review of each submission.

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

Departmental Representative where shop drawings will not be prepared due to standardized manufacture of product.

- .12 Submit electronic copies of test reports for requirements requested in specification Sections and as requested by Consultant or Departmental Representative.
 - .1 Report signed by authorized official of testing laboratory that material, product or system identical to material, product or system to be provided has been tested in accord with specified requirements.
 - .2 Testing must have been within 3 years of date of contract award for project.
- .13 Submit electronic copies of certificates for requirements requested in specification Sections and as requested by Consultant or Departmental Representative.
 - .1 Statements printed on manufacturer's letterhead and signed by responsible officials of manufacturer of product, system or material attesting that product, system or material meets specification requirements.
 - .2 Certificates must be dated after award of project contract complete with project name.
- .14 Submit electronic copies of manufacturer's instructions for requirements requested in specification Sections and as requested by Consultant or Departmental Representative.
 - .1 Pre-printed material describing installation of product, system or material, including special notices and Material Safety Data Sheets concerning impedances, hazards and safety precautions.
- .15 Submit electronic copies of Manufacturer's Field Reports for requirements requested in specification Sections and as requested by Consultant or Departmental Representative.
- .16 Documentation of the testing and verification actions taken by manufacturer's representative to confirm compliance with manufacturer's standards or instructions.
- .17 Submit electronic copies of Operation and Maintenance Data for requirements requested in specification Sections and as requested by Departmental Representative.
- .18 Delete information not applicable to project.
- .19 Supplement standard information to provide details applicable to project.
- .20 If upon review by Departmental Representative and Consultant, no errors or omissions are discovered or if only minor corrections are made, an electronic copy 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.
- .21 The review of shop drawings by Public Works and Government Services Canada (PWGSC) is for sole purpose of ascertaining conformance with general concept.

- .1 This review shall not mean that PWGSC approves detail design inherent in shop drawings, responsibility for which shall remain with Contractor submitting same, and such review shall not relieve Contractor of responsibility for errors or omissions in shop drawings or of responsibility for meeting requirements of construction and Contract Documents.
- .2 Without restricting generality of foregoing, Contractor is responsible for dimensions to be confirmed and correlated at job site, for information that pertains solely to fabrication processes or to techniques of construction and installation and for co-ordination of Work of sub-trades.

1.3 SAMPLES

- .1 Submit for review samples in duplicate as requested in respective specification Sections. Label samples with origin and intended use.
- .2 Deliver samples prepaid to Departmental Representative's business address.
- .3 Notify Departmental Representative and Consultant in writing, at time of submission of deviations in samples from requirements of Contract Documents.
- .4 Where colour, pattern or texture is criterion, submit full range of samples.
- .5 Adjustments made on samples by Departmental Representative are not intended to change Contract Price. If adjustments affect value of Work, state such in writing to Departmental Representative and Consultant prior to proceeding with Work.
- .6 Make changes in samples which Departmental Representative may require, consistent with Contract Documents.
- .7 Reviewed and accepted samples will become standard of workmanship and material against which installed Work will be verified.

1.4 MOCK-UPS

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

1.5 PHOTOGRAPHIC DOCUMENTATION

- .1 Submit electronic copy of colour digital photography in jpg format, standard resolution prior to mobilization and as directed by Departmental Representative or Consultant.
- .2 Project identification: name and number of project and date of exposure indicated.

1.6 CERTIFICATES AND TRANSCRIPTS

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

PART 2 PRODUCTS – NOT USED

PART 3 EXECUTION – NOT USED

END OF SECTION

PART 1 GENERAL

1.1 REFERENCE STANDARDS

- .1 Canada Centre for Inland Waters.
 - .1 Building and Property Technical Services (BPTS) – Lock Out Tag Out (LOTO) Reference.
- .2 Canadian Standards Association (CSA): Canada
 - .1 CSA S350-M1980(R2003), Code of Practice for Safety in Demolition of Structures.
- .3 National Building Code 2010 (NBC):
 - .1 NBC 2010, Division B, Part 8 Safety Measures at Construction and Demolition Sites.
- .4 National Fire Code 2010 (NFC):
 - .1 NFC 2010, Division B, Part 5 Hazardous Processes and Operations, subsection 5.6.1.3 Fire Safety Plan.
- .5 Canada Labour Code, Part 2, Canada Occupational Safety and Health Regulations
- .6 Province of Ontario
 - .1 Occupational Health and Safety Act and Regulations for Construction Projects, R.S.O. 1990, c.0.1, as amended and O. Reg. 213/91 as amended - Updated 2005.
 - .2 Workplace Safety and Insurance Act, 1997.
 - .3 Municipal statutes and authorities.
- .7 Treasury Board of Canada Secretariat (TBS):
 - .1 Treasury Board, Fire Protection Standard April 1, 2010, <https://www.tbs-sct.gc.ca/pol/doc-eng.aspx?id=17316§ion=text>.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Submit site-specific Health and Safety Plan: Within 7 days after date of Notice to Proceed and prior to commencement of Work. Health and Safety Plan must include:
 - .1 Results of site-specific safety hazard assessment.
 - .2 Results of safety and health risk or hazard analysis for site tasks and operation found in work plan.
- .3 Measures and controls to be implemented to address identified safety hazards and risks.
- .4 Provide a Fire Safety Plan, specific to the work location, in accordance with NBC, Division B, Article 8.1.1.3 prior to commencement of work. The plan shall be coordinated with, and integrated into, the Emergency Procedures and Evacuation Plan in place at the site. Departmental Representative will provide Emergency Procedures and Evacuation Plan. Deliver two copies of

the Fire Safety Plan to the Departmental Representative not later than 14 days before commencing work.

- .1 Emergency and Fire Evacuation Route: The Contractor shall obtain training on procedures of evacuating the site under emergency and/or fire situations. Contractor training and sign-off is required prior to initiating site work.
- .5 Contractor's and Sub-contractors' Safety Communication Plan.
- .6 Contingency and Emergency Response Plan addressing standard operating procedures specific to the project site to be implemented during emergency situations. Coordinate plan with existing Emergency Response requirements and procedures provided by Departmental Representative.
- .7 Departmental Representative will review Contractor's site-specific Health and Safety Plan and provide comments to Contractor within 5 days after receipt of plan. Revise plan as appropriate and resubmit plan to Departmental Representative within 5 days after receipt of comments from Departmental Representative.
- .8 Departmental Representative's review of Contractor's final Health and Safety plan should not be construed as approval and does not reduce the Contractor's overall responsibility for construction Health and Safety.
- .9 Submit names of personnel and alternates responsible for site safety and health.
- .10 Submit records of Contractor's Health and Safety meetings when requested.
- .11 Submit copies of Contractor's authorized representative's work site health and safety inspection reports to Departmental Representative, bi-weekly.
- .12 Submit copies of orders, directions or reports issued by health and safety inspectors of the authorities having jurisdiction.
- .13 Submit copies of incident and accident reports.
- .14 Submit Material Safety Data Sheets (MSDS).
- .15 Submit Workplace Safety and Insurance Board (WSIB)- Experience Rating Report.

1.3 FILING OF NOTICE

- .1 File Notice of Project with Provincial authorities prior to beginning of Work.

1.4 WORK PERMITS

- .1 Obtain building permits related to project prior to commencement of Work.
- .2 Worker Profile Sheet: The Contractor shall submit to the Departmental Representative a completed Worker Profile Sheet complete with all attachments including copies of licenses, certificates and permits for supporting qualifications to perform required work for a given project for each individual worker requiring access to the site. The completed Worker Profile Sheets are required for each individual worker prior to working on site.
- .3 Hot Work Permit: The Contractor shall submit a completed Hot Work Permit to the Departmental Representative for review and approval. The Departmental Representative's approval is required prior to initiating hot work.

- .4 Lock Out and Tag Out (LOTO) – Isolation Procedures: The Contractor shall submit a completed LOTO Isolation Form (Zero Energy) to the Departmental Representative for review and approval for all work requiring LOTO. The Departmental Representative's approval of isolation form is required prior to initiating LOTO work.

1.5 SAFETY ASSESSMENT

- .1 Perform site specific safety hazard assessment related to project.

1.6 MEETINGS

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

1.7 REGULATORY REQUIREMENTS

- .1 Do Work in accordance with Section 01 41 00 - Regulatory Requirements.

1.8 GENERAL REQUIREMENTS

- .1 Develop written site-specific Health and Safety Plan based on hazard assessment prior to beginning site Work and continue to implement, maintain, and enforce plan until final demobilization from site. Health and Safety Plan must address project specifications.
- .2 Departmental Representative may respond in writing, where deficiencies or concerns are noted and may request re-submission with correction of deficiencies or concerns.

1.9 RESPONSIBILITY

- .1 Be responsible for health and safety of persons on site, safety of property on site and for protection of persons adjacent to site and environment to extent that they may be affected by conduct of Work.
- .2 Contractor will be responsible and assume the role Constructor as described in the Ontario Occupational Health and Safety Act and Regulations for Construction Projects.
- .3 Comply with and enforce compliance by employees with safety requirements of Contract Documents, applicable federal, provincial, territorial and local statutes, regulations, and ordinances, and with site-specific Health and Safety Plan.

1.10 COMPLIANCE REQUIREMENTS

- .1 Comply with Ontario Occupational Health and Safety Act, R.S.O. 1990, c. 0.1 and Ontario Regulations for Construction Projects, O. Reg. 213/91.

1.11 UNFORSEEN HAZARDS

- .1 When unforeseen or peculiar safety-related factor, hazard, or condition occur during performance of Work, follow procedures in place for Employee's Right to Refuse Work in accordance with Acts and Regulations of Province of Ontario and advise Departmental Representative verbally and in writing.
- .2 When unforeseen or peculiar safety-related factor, hazard, or condition occur during performance of Work, follow procedures in accordance with Acts and

Regulations of the Province of Ontario and advise Departmental Representative verbally and in writing.

1.12 POSTING OF DOCUMENTS

- .1 Ensure applicable items, articles, notices and orders are posted in conspicuous location on site in accordance with Acts and Regulations of the Province of Ontario, and in consultation with Departmental Representative.

1.13 CORRECTION OF NON-COMPLIANCE

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

1.14 BLASTING

- .1 Blasting or other use of explosives is not permitted.

1.15 WORK STOPPAGE

- .1 Give precedence to safety and health of public and site personnel and protection of environment over cost and schedule considerations for Work.

PART 2 PRODUCTS – NOT USED

PART 3 EXECUTION – NOT USED

END OF SECTION

PART 1 GENERAL

1.1 SUMMARY

- .1 This Section references to laws, by laws, ordinances, rules, regulations, codes, orders of Authority Having Jurisdiction, and other legally enforceable requirements applicable to Work and that are; or become, in force during performance of Work.

1.2 REFERENCES TO REGULATORY REQUIREMENTS

- .1 Perform Work in accordance with National Building Code of Canada (NBC) 2010, National Fire Code of Canada (NFC) 2010 and Ontario Building Code (OBC) 2016, including amendments up to tender closing date and other codes of provincial or local application provided that in case of conflict or discrepancy, more stringent requirements apply as directed by the Departmental Representative.
- .2 Specific design and performance requirements listed in specifications or indicated on Drawings may exceed minimum requirements established by referenced Building Code; these requirements will govern over the minimum requirements listed in Building Code
- .1 Meet or exceed requirements of:
 - .1 Contract documents.
 - .2 Specified standards, codes and referenced documents.

1.3 HAZARDOUS MATERIAL DISCOVERY

- .1 Asbestos: demolition of spray or trowel-applied asbestos is hazardous to health. Stop work immediately when material resembling spray or trowel-applied asbestos is encountered during demolition work. Notify Departmental Representative.

1.4 BUILDING SMOKING ENVIRONMENT

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

1.5 QUALITY ASSURANCE

- .1 Regulatory Requirements: Except as otherwise specified, [Constructor] will apply for, obtain, and pay fees associated with, permits, licenses, certificates, and approvals required by regulatory requirements and Contract Documents, based on General Conditions of Contract and the following:
 - .1 Regulatory requirements and fees in force on date of Bid submission, and
 - .2 A change in regulatory requirements or fees scheduled to become effective after date of tender submission and of which public notice has been given before date of tender submission

PART 2 PRODUCTS – NOT USED

PART 3 EXECUTION – NOT USED

END OF SECTION

PART 1 GENERAL

1.1 RELATED REQUIREMENTS

- .1 Section 02 41 00 Hydrodemolition
- .2 Section 03 20 00 Concrete Reinforcing
- .3 Section 03 30 00 Cast-in-Place Concrete
- .4 Section 05 10 00 Structural Metal Framing
- .5 Section 05 50 00 Metal Fabrication
- .6 Section 20 04 00 Mechanical General Provisions
- .7 Section 20 05 00 Basic Mechanical Materials and Methods
- .8 Section 20 08 00 Commission
- .9 Section 20 94 00 Mechanical Demolition
- .10 Section 22 11 00 Plumbing and Drainage Piping Systems
- .11 Section 22 13 29 Bilge and Sewage Pumps
- .12 Section 26 05 00 Basic Electrical Materials and Methods
- .13 Section 26 05 05 Electrical Work General Instructions
- .14 Section 26 05 08 Demolition and Revision Work
- .15 Section 26 05 09 Electrical Work Testing
- .16 Section 26 05 21 Wires and Cables (0 – 1000 Volts)
- .17 Section 26 05 28 Grounding and Bonding
- .18 Section 26 05 31 Splitters, Junction and Pull Boxes
- .19 Section 26 05 32 Outlet Boxes, Conduit Boxes and Fittings
- .20 Section 26 05 34 Conduit Systems
- .21 Section 26 27 26 Wiring Devices
- .22 Section 26 28 23 Disconnect Switches

1.2 REFERENCE STANDARDS

- .1 Canadian Construction Documents Committee (CCDC)
 - .1 CCDC 2-94, Stipulated Price Contract.

1.3 INSPECTION

- .1 Allow Departmental Representative and Consultant access to Work. If part of Work is in preparation at locations other than Place of Work, allow access to such Work whenever it is in progress.
- .2 Give timely notice requesting inspection if Work is designated for special tests, inspections or approvals by Departmental Representative or Consultant instructions, or law of Place of Work.
- .3 If Contractor covers or permits to be covered Work that has been designated for special tests, inspections or approvals before such is made, uncover such

Work, have inspections or tests satisfactorily completed and make good such Work.

- .4 Departmental Representative or Consultant will order part of Work to be examined if Work is suspected to be not in accordance with Contract Documents. If, upon examination such work is found not in accordance with Contract Documents, correct such Work and pay cost of examination and correction.

1.4 ACCESS TO WORK

- .1 Allow access to Work, off site manufacturing and fabrication plants.
- .2 Co-operate to provide reasonable facilities for such access.

1.5 REJECTED WORK

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

1.6 MOCK-UPS

- .1 Prepare mock-ups for Work specifically requested in specifications. Include for Work of Sections required to provide mock-ups.
- .2 Construct in locations acceptable to Departmental Representative.
- .3 Prepare mock-ups for Departmental Representative and Consultant'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 Mock-ups may remain as part of Work.

PART 2 PRODUCTS – NOT USED

PART 3 EXECUTION – NOT USED

END OF SECTION

PART 1 GENERAL

1.1 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 Indicate use of supplemental or other staging area.
- .3 Provide construction facilities in order to execute work expeditiously.
- .4 Remove from site all such work after use.

1.2 SCAFFOLDING

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

1.3 HOISTING

- .1 Provide, operate and maintain hoists [cranes] required for moving of materials and equipment.
- .2 Hoists to be operated by qualified operator.

1.4 SITE STORAGE/LOADING

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

1.5 CONSTRUCTION PARKING

- .1 Parking will be permitted on site at areas designated by the Departmental Representative.
- .2 Provide and maintain adequate access to project site.
- .3 Clean runways and taxi areas where used by Contractor's equipment.

1.6 SECURITY

- .1 Contractor is responsible for securing the work area and exterior access set-up by the Contractor for purposes of this work.

1.7 EQUIPMENT, TOOL AND MATERIALS STORAGE

- .1 Provide and maintain, in clean and orderly condition, lockable weatherproof sheds for storage of tools, equipment and materials.
- .2 Locate materials not required to be stored in weatherproof sheds on site in manner to cause least interference with work activities.
- .3 Materials stored outside shall be covered with tarps to protect from weather.

1.8 SANITARY FACILITIES

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

1.9 CONSTRUCTION SIGNAGE

- .1 If approved, provide and erect project sign, within three weeks of signing Contract, in a location designated by Departmental Representative.
- .2 Construction sign 1200 x 2400mm, of wood frame and plywood construction painted with exhibit lettering produced by a professional sign painter.
- .3 Indicate on sign, name of Owner, Consultant, Departmental Representative and Contractor, of design style established by the Departmental Representative.
- .4 No other signs or advertisements, other than warning signs, are permitted on site.
- .5 Locate project identification sign where indicated by the Departmental Representative and construct as follows:
 - .1 Build concrete foundation, erect framework, and attach signboard to framing.
 - .2 Paint surfaces of signboard and framing with one coat primer and two coats enamel. Colour white on signboard face, black on other surfaces.
 - .3 Apply vinyl sign face overlay to painted signboard face in accordance with installation instruction supplied.
- .6 Direct requests for approval to erect Consultant/Contractor signboard to Departmental Representative. For consideration general appearance of Consultant/Contractor signboard must conform to project identification site sign. Wording in both official languages.
- .7 Signs and notices for safety and instruction in both official languages Graphic symbols to CAN/CSA-Z321.
- .8 Maintain approved signs and notices in good condition for duration of project and dispose of offsite on completion of project or earlier if directed by Departmental Representative.

1.10 PROTECTION AND MAINTENANCE OF TRAFFIC

- .1 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.
- .2 Protect travelling public from damage to person and property.
- .3 Contractor's traffic on roads selected for hauling material to and from site to interfere as little as possible with public traffic.
- .4 Verify adequacy of existing roads and allowable load limit on these roads. Contractor: responsible for repair of damage to roads caused by construction operations.

- .5 Provide necessary lighting, signs, barricades, and distinctive markings for safe movement of traffic.

1.11 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 – NOT USED

PART 3 EXECUTION – NOT USED

END OF SECTION

PART 1 GENERAL

1.1 INSTALLATION AND REMOVAL

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

1.2 GUARD RAILS AND BARRICADES

- .1 Provide secure, rigid guard rails and barricades around openings or floor / roof penetrations.
- .2 Provide as required by governing authorities.

1.3 WEATHER ENCLOSURES

- .1 Provide weather tight closures to unfinished areas of work.
- .2 Design enclosures to withstand wind pressure and snow loading, if applicable.

1.4 FIRE ROUTES

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

1.5 PROTECTION FOR OFF-SITE AND PUBLIC PROPERTY

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

PART 2 PRODUCTS – NOT USED

PART 3 EXECUTION – NOT USED

END OF SECTION

PART 1 GENERAL

1.1 RELATED REQUIREMENTS

- .1 Section 02 41 00 Hydrodemolition
- .2 Section 03 20 00 Concrete Reinforcing
- .3 Section 03 30 00 Cast-in-Place Concrete
- .4 Section 05 10 00 Structural Metal Framing
- .5 Section 05 50 00 Metal Fabrication
- .6 Section 20 04 00 Mechanical General Provisions
- .7 Section 20 05 00 Basic Mechanical Materials and Methods
- .8 Section 20 08 00 Commissioning
- .9 Section 20 94 00 Mechanical Demolition
- .10 Section 22 11 00 Plumbing and Drainage Piping Systems
- .11 Section 22 13 29 Bilge and Sewage Pumps
- .12 Section 26 05 00 Basic Electrical Materials and Methods
- .13 Section 26 05 05 Electrical Work General Instructions
- .14 Section 26 05 08 Demolition and Revision Work
- .15 Section 26 05 09 Electrical Work Testing
- .16 Section 26 05 21 Wires and Cables (0 – 1000 Volts)
- .17 Section 26 05 28 Grounding and Bonding
- .18 Section 26 05 31 Splitters, Junction and Pull Boxes
- .19 Section 26 05 32 Outlet Boxes, Conduit Boxes and Fittings
- .20 Section 26 05 34 Conduit Systems
- .21 Section 26 27 26 Wiring Devices
- .22 Section 26 28 23 Disconnect Switches

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 products or systems are in conformance with applicable standards, the Departmental Representative reserves right to have such products or systems tested to prove or disprove conformance.
- .4 Cost for such testing will be borne by Departmental Representative in event of conformance with Contract Documents or by Contractor in event of non-conformance.

- .5 Conform to latest date of issue of referenced standards in effect on date of submission of bids, except where specific date or issue is specifically noted.

1.3 QUALITY

- .1 Products, materials, equipment and articles incorporated in Work shall be new, not damaged or defective, and of best quality for purpose intended. If requested, furnish evidence as to type, source and quality of products provided.
- .2 Procurement policy is to acquire, in cost effective manner, items containing highest percentage of recycled and recovered materials practicable consistent with maintaining satisfactory levels of competition. Make reasonable efforts to use recycled and recovered materials and in otherwise utilizing recycled and recovered materials in execution of work.
- .3 Defective products, whenever identified prior to completion of Work, will be rejected, regardless of previous inspections. Inspection does not relieve responsibility but is precaution against oversight or error. Remove and replace defective products at own expense and be responsible for delays and expenses caused by rejection.
- .4 Should disputes arise as to quality or fitness of products, decision rests strictly with Departmental Representative based upon requirements of Contract Documents.
- .5 Unless otherwise indicated in specifications, maintain uniformity of manufacture for any particular or like item throughout building.
- .6 Permanent labels, trademarks and nameplates on products are not acceptable in prominent locations, except where required for operating instructions, or when located in mechanical or electrical rooms.

1.4 AVAILABILITY

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

1.5 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.
- .3 Store products subject to damage from weather in weatherproof enclosures or cover with tarps.

- .4 Materials stored on the roof surface shall be elevated off the roof.
- .5 Protect the new and existing roof membrane with plywood or insulation.
- .6 Remove oily rags and other combustible debris from site daily. Take every precaution necessary to prevent spontaneous combustion.
- .7 Remove and replace damaged products at own expense and to satisfaction of Departmental Representative and Consultant.
- .8 Touch-up damaged factory finished surfaces to Departmental Representative's satisfaction. Use touch-up materials to match original. Do not paint over name plates.

1.6 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 products in accordance with manufacturer's instructions. Do not rely on labels or enclosures provided with products. Obtain written instructions directly from manufacturers.
- .2 Notify Departmental Representative in writing, of conflicts between specifications and manufacturer's instructions, so that Departmental Representative will establish course of action.
- .3 Improper installation of products, due to failure in complying with these requirements, authorizes the Consultant or Departmental Representative to require removal and reinstallation 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 Departmental Representative if required Work is such as to make it impractical to produce required results.
- .2 Do not employ anyone unskilled in their required duties. Departmental Representative reserves right to require dismissal from site, workers deemed incompetent or careless.
- .3 Decisions as to standard or fitness of Quality of Work in cases of dispute rest solely with Departmental Representative, whose decision is final.

1.9 CO-ORDINATION

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

1.10 CONCEALMENT

- .1 Before concealing pipes, ducts or wiring, inform Consultant for review. Notify the Departmental Representative and Consultant if there is interference. Install as directed by Departmental Representative.

1.11 REMEDIAL WORK

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

1.12 LOCATION OF FIXTURES

- .1 Consider location of fixtures, outlets, and mechanical and electrical items indicated as approximate.
- .2 Inform Departmental Representative and Consultant of conflicting installation. 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 parts of building. Do not cut, drill or sleeve load bearing structural member, unless specifically indicated without written approval of Departmental 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.

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

PART 2 PRODUCTS – NOT USED

PART 3 EXECUTION – NOT USED

END OF SECTION

PART 1 GENERAL

1.1 ACTION AND INFORMATIONAL SUBMITTALS

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

1.2 MATERIALS

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

1.3 PREPARATION

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

1.4 EXECUTION

- .1 Execute cutting, fitting, and patching to complete Work.
- .2 Fit several parts together, to integrate with other Work.
- .3 Uncover Work to install ill-timed Work.
- .4 Remove and replace defective and non-conforming Work.
- .5 Provide openings in non-structural elements of Work for penetrations of mechanical and electrical Work.

- .6 Execute Work by methods to avoid damage to other Work, and which will provide proper surfaces to receive patching and finishing.
- .7 Employ original installer to perform cutting and patching for weather-exposed and moisture-resistant elements, and sight-exposed surfaces.
- .8 Restore work with new products in accordance with requirements of Contract Documents.
- .9 Refinish surfaces to match adjacent finishes: Refinish continuous surfaces to nearest intersection. Refinish assemblies by refinishing entire unit.

PART 2 PRODUCTS – NOT USED

PART 3 EXECUTION – NOT USED

END OF SECTION

PART 1 GENERAL

1.1 PROJECT CLEANLINESS

- .1 Maintain Work in tidy condition, free from accumulation of waste products and debris, other than that caused by Owner or other Contractors.
- .2 Remove waste materials from site at daily regularly scheduled times or dispose of as directed by Departmental Representative. Do not burn waste materials.
- .3 Make arrangements with and obtain permits from authorities having jurisdiction for disposal of waste and debris.
- .4 Provide on-site containers for all waste materials and debris.
- .5 Use only cleaning materials recommended by manufacturer of surface to be cleaned, and as recommended by cleaning material manufacturer.

1.2 FINAL CLEANING

- .1 Remove waste products and debris other than that caused by others and leave Work clean and suitable for use.
- .2 Prior to final review remove surplus products, tools, construction machinery and equipment.
- .3 Broom clean and wash exterior walks, steps and surfaces; rake clean other surfaces of grounds.
- .4 Remove dirt and other disfiguration from exterior surfaces.
- .5 Clean and sweep roofs.
- .6 Sweep and wash clean paved areas.

PART 2 PRODUCTS – NOT USED

PART 3 EXECUTION – NOT USED

END OF SECTION

PART 1 GENERAL

1.1 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.
 - .2 Notify Departmental Representative and Consultant in writing of satisfactory completion of Contractor's inspection and submit verification that corrections have been made.
 - .3 Request Consultant's and Departmental Representative inspection.
- .2 Consultant's and Departmental Representative Inspection:
 - .1 Consultant, Departmental Representative and Contractor to inspect Work and identify defects and deficiencies.
 - .2 Contractor to correct Work as directed.
- .3 Completion Tasks: submit written certificates in English that tasks have been performed as follows:
 - .1 Work: completed and inspected for compliance with Contract Documents.
 - .2 Defects: corrected and deficiencies completed.
 - .3 Equipment and systems affected by the work: tested, adjusted and fully operational.
 - .4 Operation of systems: demonstrated to Owner's personnel.
 - .5 Work: complete and ready for final inspection.
- .4 Final Inspection:
 - .1 When completion tasks are done, request final inspection of Work by Consultant, Departmental Representative, and Contractor.
 - .2 When Work incomplete according to Consultant or Departmental Representative, complete outstanding items and request re-inspection.

1.2 FINAL CLEANING

- .1 Clean in accordance with Section 01 74 00 - Cleaning.
- .2 Remove surplus materials, excess materials, rubbish, tools and equipment.

PART 2 PRODUCTS – NOT USED

PART 3 EXECUTION – NOT USED

END OF SECTION

PART 1 GENERAL

1.1 ADMINISTRATIVE REQUIREMENTS

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

1.2 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 Departmental Representative, one copy of operating and maintenance manuals in English.
- .3 Provide evidence, if requested, for type, source and quality of products supplied.

1.3 FORMAT

- .1 Organize data as instructional manual.
- .2 Binders: vinyl, hard covered, 3 'D' ring, loose leaf 219 x 279 mm with spine and face pockets.
- .3 When multiple binders are used correlate data into related consistent groupings.
 - .1 Identify contents of each binder on spine.
 - .4 Cover: identify each binder with type or printed title 'Project Record Documents'; list title of project and identify subject matter of contents.
 - .5 Arrange content with Section numbers and sequence of Table of Contents.
 - .6 Provide tabbed fly leaf for each separate product and system, with typed description of product and major component parts of equipment.
 - .7 Text: manufacturer's printed data, or typewritten data.

- .8 Drawings: provide with reinforced punched binder tab.
 - .1 Bind in with text; fold larger drawings to size of text pages.
- .9 Provide 1:1 scaled CAD files in .dxf and pdf format on CD or flash drive.

1.4 CONTENTS - PROJECT RECORD DOCUMENTS

- .1 Table of Contents for Each Volume: provide title of project;
 - .1 Date of submission; names.
 - .2 Addresses, and telephone numbers of Consultant and Contractor with name of responsible parties.
 - .3 Schedule of products and systems, indexed to content of volume.
- .2 For each product or system:
 - .1 List names, addresses and telephone numbers of subcontractors and suppliers, including local source of supplies.
- .3 Product Data: mark each sheet to identify specific products and component parts, and data applicable to installation; delete inapplicable information.
- .4 Drawings: as required to supplement product data.
- .5 Typewritten Text: as required to supplement product data.
 - .1 Provide logical sequence of instructions for each procedure, incorporating manufacturer's instructions.

1.5 AS -BUILT DOCUMENTS AND SAMPLES

- .1 Maintain, in addition to requirements in General Conditions, at site for Consultant or Departmental Representative, one record copy of:
 - .1 Contract Drawings.
 - .2 Specifications.
 - .3 Addenda.
 - .4 Change Orders and other modifications to Contract.
 - .5 Reviewed shop drawings, product data, and samples.
 - .6 Field test records.
 - .7 Inspection certificates.
 - .8 Manufacturer's certificates.
- .2 Store record documents and samples in field office apart from documents used for construction.
- .3 Label record documents and file in accordance with Section number listings in List of Contents of this Project Manual.
 - .1 Label each document "PROJECT RECORD" in neat, large, printed letters.
- .4 Maintain record documents in clean, dry and legible condition.
 - .1 Do not use record documents for construction purposes.
- .5 Keep record documents and samples available for inspection by Consultant or Departmental Representative.

1.6 RECORDING INFORMATION ON PROJECT RECORD DOCUMENTS

- .1 Record information on set of black line opaque drawings, and in copy of Project Manual.
- .2 Use felt tip marking pens, maintaining separate colours for each major system, for recording information.
- .3 Record information concurrently with construction progress.
 - .1 Do not conceal Work until required information is recorded.
- .4 Contract Drawings and shop drawings: mark each item to record actual construction, including:
 - .1 Measured depths of elements of foundation in relation to finish first floor datum.
 - .2 Field changes of dimension and detail.
 - .3 Changes made by change orders.
 - .4 Details not on original Contract Drawings.
 - .5 Referenced Standards to related shop drawings and modifications.
- .5 Specifications: mark each item to record actual construction, including:
 - .1 Manufacturer, trade name, and catalogue number of each product actually installed, particularly optional items and substitute items.
 - .2 Changes made by Addenda and change orders.
- .6 Other Documents: maintain Consultant site visit reports, manufacturer's site visit reports, inspection certifications, and that required by individual specifications sections.
- .7 Provide digital photos, if requested, for site records.

1.7 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 Additional requirements: as specified in individual specifications sections.

1.8 WARRANTIES AND BONDS

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

- .5 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.
- .6 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.
- .7 Conduct joint 6 month and 12 month warranty inspection, measured from time of acceptance, by Departmental Representative.
- .8 Include information contained in warranty management plan as follows:
 - .1 Roles and responsibilities of personnel associated with warranty process, including points of contact and telephone numbers within the organizations of Contractors, subcontractors, manufacturers or suppliers involved.
 - .2 Contractor's plans for attendance at 6 and 12 month post-construction warranty inspections.
- .9 Respond in timely manner to oral or written notification of required construction warranty repair work.
- .10 Written verification to follow oral instructions.
 - .1 Failure to respond will be cause for the Departmental Representative to proceed with action against Contractor.

PART 2 PRODUCTS – NOT USED

PART 3 EXECUTION – NOT USED

END OF SECTION

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PART 1 – GENERAL

1.1 GENERAL REQUIREMENTS

- .1 Division 2, Selective Interior Demolition.

1.2 WORK INCLUDED

- .1 Concrete Removal Using Hydrodemolition

1.3 DESCRIPTION

- .1 This section addresses the concrete removal work to be performed using hydrodemolition. The depth of concrete removal required will be shown on the drawings and/or specifications. This section includes all labor, materials, equipment and supervision necessary to remove existing concrete using hydrodemolition as indicated on the drawings and in the specifications, including, but not limited to:
 - I. Removal of concrete by means of hydrodemolition.
 - II. Removal of concrete inaccessible to the hydrodemolition machine with hand-held water blasting equipment or conventional chipping hammers, including shadows under the reinforcing steel.
 - III. Containment, collection, treatment, and disposal of hydrodemolition wastewater and water used for cleanup.
 - IV. Collection of debris from the demolition operation using a vacuum system and disposal of all debris.
 - V. Final preparation of surface prior to placement of concrete.

1.4 REFERENCES

- .1 International Concrete Repair Institute (ICRI) Technical Guideline 310.3R-2014 Guide for the Preparation of Concrete Surfaces for Repair Using Hydrodemolition Methods.
- .2 ACI RAP-14: Field Guide to Concrete Repair Application Procedures – Concrete Removal Using Hydrodemolition.

1.5 SUBMITTALS

- .1 Submit the following items prior to beginning hydrodemolition operations:
 - I. Hydrodemolition equipment specifications, including robot size and weight, supply water requirements, water consumption, and ultra-high-pressure hose specifications.
 - II. Location and layout of the hydrodemolition equipment.
 - III. Location and layout of the temporary water supply, including materials to be used and any permits required to secure the use of the water.

- IV. Vacuum equipment specifications, including type, manufacturer, capacities, and filtration systems.
- V. Location and layout of any fuel system required for the equipment.
- VI. Debris removal equipment specifications and method for concrete debris removal. The debris removal process must not impact the ongoing hydrodemolition operations.
- VII. Location and layout of the wastewater containment, treatment and disposal system(s), including any permits required to properly discharge the water.
- VIII. Copies of hydrodemolition water quality tests performed.
- IX. Qualification certification(s) of the hydrodemolition operator.
- X. Hand-held water blasting equipment and/or chipping hammer specifications to be used for detail chipping, if necessary.
- XI. Equipment to be used for final wash down of the hydrodemolished surface to create a pour-ready surface.

1.6 QUALITY CONTROL

- .1 Hydrodemolition companies, as well as individual employees performing and supervising hydrodemolition concrete removal, must meet the following requirements:
 - I. Work shall be performed by organizations that have successfully performed at least ten verifiable projects similar in scope to this project within the last three years.
 - II. Work shall be under the immediate control of a person experienced in hydrodemolition who has supervised five verifiable projects of similar type and size within the last three years. Supervising personnel shall be present during all operations.
 - III. The hydrodemolition equipment operator must be trained and certified by the equipment manufacturer in the proper use and safe operation of the equipment and have a minimum of two years' experience with the equipment on jobs of similar type and size.

PART 2 – PRODUCTS

2.1 HYDRODEMOLITION EQUIPMENT

Concrete removals shall be performed with a computerized, self-propelled hydrodemolition machine that utilizes a 36,000 psi ultra-high-pressure water jet stream and required water consumption of 16 gallons per minute (or less) per pump. Equipment shall be capable of removing concrete to the depth specified herein and/or as shown on the drawings and shall be capable of removing rust and laitance from exposed reinforcement designated to remain in place. The equipment shall be capable of removing concrete to within one inch of vertical surfaces. Independent of the number of passes required to achieve the specified depth of removal, rotary heads only shall be used for the final pass of the hydrodemolition machine.

Hand-held high-pressure [10,000 psi (690 bar) minimum] wands or 35 lb. (16 kg) maximum

jackhammers shall be used in areas that are inaccessible to the self-propelled machine or in patching areas that require work to remove the remaining unsound concrete.

2.2 VACUUM EQUIPMENT

Vacuum equipment shall be of sufficient capacity to collect all debris from the hydrodemolition operation. The vacuum equipment shall be capable of removing wet debris and water in the same pass.

2.3 WASTEWATER TREATMENT EQUIPMENT

All wastewater collected must be treated in accordance with Federal, State and Local requirements for water quality and discharge capability. The wastewater treatment equipment utilized must be capable of adjusting the pH, lowering the Total Suspended Solids (TSS), and lowering the turbidity of the wastewater. At a minimum, wastewater shall be treated to reduce Total Suspended Solids (TSS) to < 20 mg/L, Nephelometric Turbidity Units (NTUs) to < 50, and pH to between 6.0 and 9.0. Some jurisdictions may have more stringent treatment requirements.

2.4 TESTING

Testing and Acceptance of the Hydrodemolition Equipment. Prior to the commencement of the hydrodemolition concrete removal operation, the equipment shall be calibrated on an area of sound concrete as designated by the Engineer. In case of an existing overlay, calibration shall be performed on original deck concrete that is sound and not on any concrete overlay material. After calibration, the equipment shall be moved to a known unsound area to verify that all unsound concrete is removed by the established recorded settings. Each test area (sound and unsound) shall be approximately 50 square feet. If a satisfactory result is obtained, the minimum depth and quality of removal demonstrated in the test areas shall be used for the hydrodemolition production.

The Engineer shall verify the following settings:

- IV. Water pressure gauge (36,000 psi minimum)
- V. Water usage/flow rate (16 gallons per minute per pump minimum)
- VI. Machine staging control (step)
- VII. Nozzle size
- VIII. Nozzle speed (travel)

During the calibration, any or all of the above settings may be modified in order to achieve removal of all unsound concrete. The settings may be changed by the Hydrodemolition Contractor to achieve total removal of unsound concrete, but the Engineer must be notified of all changes. The Engineer may with input of the Hydrodemolition Contractor change any or all of the settings in order to achieve the goal of removing unsound concrete with hydrodemolition. Calibration shall be required on each structure, each time hydrodemolition is performed, and as required to achieve the results specified by the plan.

3.1 HYDRODEMOLITION REMOVAL

- .1 Execution of the hydrodemolition concrete removal shall include the following:
 - I. Protect and/or relocate existing utilities within the work area that may be damaged during the hydrodemolition work. Provide temporary service until affected utilities are restored.
 - II. Install temporary protection and other safety requirements prior to starting hydrodemolition. The General Contractor shall adequately shield the work area to prevent debris resulting from the hydrodemolition operation from traveling beyond the boundaries of the work area in order to protect the public from flying debris both around and/or under the work area.
 - III. Provide adequate lighting as required to perform the work of this section.
 - IV. Remove the concrete in the areas designated on the drawings using hydrodemolition to the depth specified in the drawings, in these specifications, and as demonstrated and approved by the Engineer in the hydrodemolition test cut area. Maintain the quality and depth of cut demonstrated in the test area throughout the project. If delaminations exist beyond the minimum removal depth, removals shall continue until all unsound and delaminated concrete has been removed.
 - V. Areas inaccessible to the hydrodemolition equipment shall be removed using hand-held high-pressure water blasting or pneumatic tools. If the hydrodemolition removal exposes reinforcing steel, then shadows under reinforcing steel scheduled to remain in place shall be removed to $\frac{3}{4}$ inches below the steel using hand-held high-pressure water blasting or pneumatic tools.
 - VI. Clean the area to remove all loose debris and other materials scheduled to be removed during the hydrodemolition. Thoroughly clean the demolished area using a water blaster held at a maximum of 12" from the surface. The surface shall be vacuumed immediately following the high-pressure water cleaning to remove any debris or wastewater. Following the cleaning, the surface shall be free of all debris, loose material, slurry, cement paste and any other material that might interfere with the bond of the new concrete overlay leaving a pour-ready surface.
 - VII. Areas where pneumatic tools were used must be thoroughly cleaned to remove rust and laitance from existing reinforcing.
 - VIII. Any areas contaminated by materials detrimental to a good bond as a result of the General Contractor's operations shall require additional removals and/or cleaning until a clean surface is obtained, at no additional cost to the owner.
 - IX. At all locations where exposed reinforcement is designated to remain in place, exercise caution to avoid damaging the reinforcement during removal of concrete. Any reinforcement damaged by these operations shall be repaired or replaced at no cost to the owner.

3.2 SUPPLY WATER

- .1 All water used for hydrodemolition operations must be potable water. The owner shall designate the location from which the General Contractor shall obtain potable water. The General Contractor is responsible for supplying all material, equipment and tools necessary to tap into the water source.

3.3 CLEAN UP SOLID DEBRIS AND WATER

- .1 All debris shall be removed quickly enough to prevent rebonding of the concrete debris to the hydrodemolished surface. Solid debris shall be collected using vacuum equipment. Water collected during the hydrodemolition operation shall be directed to a wastewater collection system. Solid debris shall be properly disposed of with other concrete debris.

3.4 WASTEWATER CONTAINMENT, TREATMENT, AND DISPOSAL

- .1 Wastewater containment shall be the sole responsibility of the General Contractor. The General Contractor shall provide a comprehensive plan for hydrodemolition wastewater containment, treatment, and disposal. At no time, shall water be allowed to run freely into other areas of the structure, or directly into the environment.
- .2 All equipment needed, including piping, pumps, hoses, settling areas and pH adjustment equipment (if needed) required for the proper collection, clean up and disposal of wastewater from the work area shall be provided and maintained by the General Contractor. The system shall be designed by the General Contractor and approved by the engineer to meet the discharge requirements of the local governing authority.
- .3 The General Contractor shall obtain any permits required for the discharge of the wastewater. The General Contractor shall establish and maintain any testing program required by the local governing authority for the wastewater discharge.
- .4 All wastewater generated by the General Contractor's operations including hydrodemolition and clean up water must be contained by the General Contractor and must pass through the General Contractor's approved collection system. No water will be allowed to flow directly into any drainage system without pre-treatment. At no time will wastewater be allowed to enter any body of water (river, lakes, ponds, etc.)
- .5 At a minimum, wastewater shall be treated to reduce Total Suspended Solids (TSS) to < 20 mg/L, Nephelometric Turbidity Units (NTUs) to < 50, and pH to between 6.0 and 9.0. Some jurisdictions may have more stringent treatment requirements. All wastewater treatment must meet the discharge requirements of Provincial or Local entities. With a valid permit, treated wastewater can be discharged into sanitary sewer systems, land discharged in areas where this is permitted, or hauled via tanker truck to a local wastewater treatment plant.
- .6 The General Contractor shall remove daily from the site all concrete debris, sludge and other materials generated by his work and legally dispose of all such materials.

3.5 INSPECTION OF EXPOSED SURFACES AND REINFORCEMENT

- .1 After the hydrodemolition, when surface preparation operation has completed the initial pass and the deck is dry and frost free, resound the deck to ensure that all unsound material has been removed. Remove unsound materials detected by the Engineer by pneumatic hammers (not heavier than 30-pound class) or by hydrodemolition.
- .2 After removals are complete, but prior to final cleaning, all exposed concrete surfaces and all reinforcement designated to remain in place will be inspected by the engineer for compliance with the plans and specifications. Where the engineer finds unsatisfactory surface preparation, the engineer will direct the General Contractor to perform additional removals. The Engineer will re-inspect after additional removals. If reinforcing steel is exposed during the hydrodemolition operation, the engineer will inspect all reinforcement designated to remain in place for defects due to corrosion or damage

caused from General Contractor's removal operations.

3.6 GENERAL REQUIREMENTS

- .1 During concrete removal do not damage existing reinforcement steel intended to remain in place.
- .2 Do not drive or place equipment in the work area that may damage the reinforcing steel to remain in place. Bars that are bent or damaged shall be replaced by the General Contractor at no charge to the Owner.
- .3 Following removal of debris, and prior to placement of new reinforcement steel, the entire surface shall be cleaned to remove any contamination or loose material remaining in the area.
- .4 All water from the hydrodemolition and cleaning process must be contained within the construction barrier limits of the work area.
- .5 Following final preparation of the area, including all other work items that must be completed prior to placement of concrete, but before final inspection and placement of concrete, the area shall be thoroughly cleaned using a water blaster with a rotating, multi-jet nozzle held at not more than 12 inches from the surface. Following the final cleaning, the surface shall be clean and free from all dirt, debris, slurry or any other material that might interfere with the bond of the new overlay.

END OF SECTION

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PART 1 - GENERAL

1.1 GENERAL REQUIREMENTS

- .1 Division 1, General Requirements, is a part of this Section and shall apply as if repeated here.

1.2 WORK IN OTHER SECTIONS

.1 Related Work Specified in Other Sections

Section 03 10 00	:	Concrete Forming and Accessories
Section 03 30 00	:	Cast-in-Place Concrete

1.3 REFERENCE STANDARDS

CSA-A23.1-14: Concrete Materials and Methods of Concrete Construction
CSA-A23.2-14: Test Methods and Standard Practices for Concrete
CSA A23.3-14: Design of Concrete Structures
CSA G30.5-M1983 (R1998): Welded Steel Wire Fabric for Concrete Reinforcement
CSA G30.18-09 (R2014): Carbon Steel Bars for Concrete Reinforcement
ACI 315-2004 (SP66): Detailing Manual
ACI 315R-04: Manual of Structural and Placing Drawings for Reinforced Concrete Structures
CSA W186-M1990 (R2012): Welding of Reinforcing Bars in Reinforced Concrete Construction

1.4 SHOP DRAWINGS

- .1 Submit shop drawings in accordance with Section 01 33 00 Submittal Procedures.
- .2 Indicate bar sizes, spacing, location and quantities of reinforcement, mesh, mechanical splices, chairs, spacers and hangers with identifying code marks to permit correct placement without reference to structural drawings; (to Reinforcing Steel Manual of Standard Practice - Metric Supplement 2004 by Reinforcing Steel Institute of Ontario).
- .3 Detail placement of reinforcing where special conditions occur.
- .4 Design and detail lap lengths and bar development lengths to CSA-A23.3-14, unless otherwise indicated.

1.5 SUBSTITUTES

- .1 Substitution of different size bars permitted only upon written approval of the Consultant.

PART 2 - PRODUCTS

2.1 MATERIALS

- .1 Reinforcing Steel: billet steel, deformed bars to CAN/CSA G30.18-09 (R2014) epoxy coated, unless indicated otherwise. Use Grade 400R bars for all reinforcing unless

noted otherwise, to sizes as shown on the drawings.

- .2 Welded Wire Fabrics: Where no reinforcement is shown, provide 152 x 152 MW 18.7 x MW 18.7 (6" x 6" x 6/6) welded wire fabric at 37mm (1½ ") below the finished surface of slabs on grade or walks, or toppings 62mm (2½") in thickness or greater. Lap ends and sides of fabric in accordance with requirements of CSA Standard CAN/CSA-A23.1, but in any event, not less than 300mm (12").

PART 3 – EXECUTION

3.1 FABRICATION

- .1 Fabricate reinforcing in accordance with CSA-A23.1.
- .2 Obtain Consultant's approval for locations of reinforcement splices other than shown on steel placing drawings.
- .3 Ship bundles of bar reinforcement clearly identified in accordance with bar list.

3.2 STORAGE OF REINFORCING

- .1 Reinforcing shall be stored off the ground to keep it free from dirt and to maintain its fabricated form.

3.3 FIELD BENDING

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

3.4 PLACING

- .1 Place reinforcing steel as indicated on reviewed shop drawings and in accordance with CSA-A23.1.
- .2 Obtain Engineer's approval of reinforcing steel and position.
- .3 Locate reinforcing bars to provide proper concrete cover. Reinforcing cover will be carefully inspected by the Consultant and reinforcing with inadequate cover will not be acceptable.
- .4 Fold all the wires behind bars, away from form faces.
- .5 Modify bars on site to accommodate box-outs, inserts, etc., as directed by the Consultant.

3.5 FIELD CUTTING OF REINFORCING

- .1 Field cut reinforcing bars only where permitted by the Consultant.

END OF SECTION

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PART 1 - GENERAL

1.1 GENERAL REQUIREMENTS

- .1 Division 1, General Requirements, is a part of this section and shall apply as if repeated here.

1.2 WORK IN OTHER SECTIONS

- .1 Related Work Specified in Other Sections

Section 03 10 00	:	Concrete Forming and Accessories
Section 03 20 00	:	Concrete Reinforcing
Section 05 10 00	:	Structural Metal Framing
Section 05 50 00	:	Metal Fabrications
Division 15	:	Mechanical
Division 16	:	Electrical

1.3 REFERENCE STANDARDS

CSA-A23.1-14 – Concrete Materials and Methods of Concrete Construction
CSA A23.2-14 – Test Methods and Standard Practices for Concrete
CAN/CSA-A3001: Portland Cement
CAN/CSA-A23.5-M86: Supplementary Cementing Materials
ASTM C595/C595M-16: Blended Hydraulic Cement
CSA G30.3-M1983 (R1998): Cold-Drawn Steel Wire for Concrete Reinforcement
ASTM A820/A820M-16, Standard Specification for Steel Fibres for Fibre Reinforced Concrete.

1.4 SAMPLES

- .1 At least (3) weeks prior to commencing work, inform the Consultant of the proposed mix design and proposed source of ready mixed concrete.
- .2 A sample of the finishes shall be prepared and remain as the minimum acceptable standard for the project.

1.5 CERTIFICATES

- .1 Provide certification that plant, equipment, and materials to be used in concrete comply with requirements of CSA-A23.1.
- .2 Provide certification that mix proportions selected will produce concrete of specified quality and yield and that strength will comply with CSA-A23.1.

1.6 QUALITY ASSURANCE

- .1 The Contractor shall employ an independent inspection and testing company to carry out all testing and inspection as required. The Consultant will appoint the inspection and testing company. The cost of inspection and testing shall be paid by the Contractor, out of the Cash Allowance carried for this testing under Division 1.
- .2 Samples and methods of moulding shall conform to the requirements of CSA-A23.2.

- .3 Additional testing shall be made if there is a distinct change in job conditions or if required by the Consultant or the authority having jurisdiction.
- .4 Compression tests shall be performed in accordance with CSA-A23.2 and good practice.
- .5 Failure to meet strength requirements will result in rejection of materials, strengthening or replacement of those portions that failed to develop the specified strength.
- .6 Concrete slump shall be tested at time that cylinders are cast and at such other times deemed necessary.
- .7 The addition of water and admixtures on the site is hereby prohibited and unacceptable for the project.

1.7 SUBMITTALS

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

1.8 WASTE MANAGEMENT AND DISPOSAL

- .1 Designate a cleaning area for tools to limit water use and runoff.
- .2 Carefully coordinate the specified concrete work with weather conditions.
- .3 Ensure emptied containers are sealed and stored safely for disposal away from children.
- .4 Prevent plasticizers, water-reducing agents and air-entraining agents from entering drinking water supplies or streams. Using appropriate safety precautions, collect liquid or solidify liquid with an inert, non-combustible material and remove for disposal. Dispose of all waste in accordance with applicable local, provincial and national regulations.
- .5 Choose least harmful, appropriate cleaning method which will perform adequately.

PART 2 – PRODUCTS

2.1 MATERIALS

- .1 Formwork: As specified in Section 03 10 00 Concrete Forming and Accessories.
- .2 Form Coating: Formaseal, as manufactured by Sternson Construction Products.
- .3 Joint Tape: Non-staining, water impermeable, self-releasing.
- .4 Form Ties: Removable or snap-off metal ties, fixed or adjustable length, free of devices leaving holes larger than 25mm diameter in concrete surface, and not leaving metal closer than 25mm to the surface of the concrete.
- .5 Tie Hole Plugs: 25mm dia. tapered P.V.C. hole plugs.

- .6 Reinforcing Steel: As specified in Section 03 20 00 – Concrete Reinforcing.
- .7 Portland Cement: to CAN/CSA-A3001, Type GU.
- .8 Water: to CSA-A23.1.
- .9 Aggregates: To CSA-A23.1. Coarse aggregates to be normal density. Use blend of 10mm and 20mm for coloured patterned concrete slabs.
- .10 Air Entraining Admixture: To CAN/CSA3-A23.5.
- .11 Chemical Admixtures: To CAN/CSA3-A23.5 water reducing type WN. Consultant to approve accelerating or set retarding admixtures during cold and hot weather placing.
- .12 Non-Shrink Grout: Sternson M-Bed Superflow or approved equal.
- .13 Exterior Cure and Seal Compound: Exterior concrete slabs and gutters shall be W. R. Meadows "Sealtight CS-309".
- .14 Joint and Sawcut Filler: Shall be Loadflex by Sternson or Jointflex by CPD.
- .15 Joint Tape: Shall be Sealtight Gusset Tape by W. R. Meadows.
- .16 Premoulded Membrane: Shall be Sealtight 7100-312 (PMPC), W. R. Meadows.

2.2 CONCRETE MIXES

- .1 Proportion normal density concrete in accordance with CSA A23.1, to give following properties for concrete in foundation walls, footings and any other unspecified concrete:
 - .1 Cement: Type GU Portland cement, minimum 325 kg/m³
 - .2 Maximum 25% slag cement content
 - .3 Minimum compressive strength at 28 days: 30 MPa.
 - .4 Nominal size of coarse aggregate: 20 mm.
 - .5 Slump at time and point of discharge: 50 to 100 mm.
 - .6 Class of Exposure F-1
 - .7 Air content: 0 to 3%.
- .2 Proportion normal density concrete in accordance with CSA-A23.1, Alternative 1 to give following properties: for concrete in structural slabs:
 - .1 Cement: Type GU Portland cement, minimum 295 kg/m³
 - .2 Maximum 25% slag cement content
 - .3 Minimum compressive strength at 28 days: 30 MPa.
 - .4 Nominal size of coarse aggregate: 20 mm.
 - .5 Slump at time and point of discharge: 60 to 100 mm.
 - .6 Class of Exposure: C-2
 - .7 Air content: 0 - 3% maximum.
- .3 Proportion normal density concrete in accordance with CSA-A23.1, to give following properties: for concrete in exterior structural slabs and sidewalks/curbs:
 - .1 Cement: Type GU Portland cement, minimum 275 kg/m³

- .2 Maximum 25% slag cement content
 - .3 Minimum compressive strength at 28 days: 32 MPa.
 - .4 Class of exposure: C-2.
 - .5 Nominal size of coarse aggregate: 20 mm.
 - .6 Slump at time and point of discharge: 60 to 100 mm.
 - .7 Air content: 5 to 8%.
- .4 Proportion normal density concrete in accordance with CSA-A23.1, to give following properties: for concrete fill.
- .1 Cement: Type GU Portland cement, minimum 250 kg/m³
 - .2 Maximum 25% slag cement content
 - .3 Minimum compressive strength at 28 days: 10 MPa.
 - .4 Nominal size of coarse aggregate: 10 mm/20 mm.
 - .5 Slump at time and point of discharge: 100 mm.
 - .6 Air content: 0 - 4% maximum.
- .5 Do not change job mix formula without prior approval of the Consultant.
- .6 In addition to 28-day strength tests, 7 days test may be carried out. If average strength at 7 days is less than 70% of specified 28-day strength, check mix at once and adjust to ensure required strength is obtained.

PART 3 - EXECUTION

3.1 WORKMANSHIP

- .1 All concrete shall be as set forth in CSA-A23.1 and shall be composed of cement, fine and coarse aggregates and water.
- .2 Concrete shall be delivered and discharged within 1½ hours after the introduction of the mixing water at the batch plant.
- .3 Mixing, placing, compaction, curing, hot and cold weather protection shall conform to CSA-A23.1. Use power vibrators in sufficient number and in location and duration to the Consultant's complete satisfaction as required.
- .4 Obtain the Consultant's approval before placing concrete. Provide 24-hour notice prior to placing of concrete.
- .5 Pumping of concrete is permitted only after approval of equipment and mix.
- .6 Ensure reinforcement and inserts are not disturbed during concrete placement in order to maintain proper coverage.
- .7 Prior to placing of concrete obtain the Consultant's approval of proposed method for protection of concrete during placing and curing in adverse weather.
- .8 Maintain accurate records of poured concrete items to indicate date, location of pour, quality, air temperature and test samples taken.
- .9 Do not place load upon new concrete until authorized by the Consultant.

3.2 FORMWORK

- .1 Verify lines, levels and column centres before proceeding with formwork and ensure dimensions agree with drawings.
- .2 Construct forms to produce finished concrete conforming to shape, dimensions, locations and levels indicated within tolerances required by CSA-A23.1.
- .3 Align form joints and make watertight. Keep form joints to minimum.
- .4 Use 25mm chamfer strips on all vertical and horizontal corners of exterior retaining walls as indicated on drawings.
- .5 All surfaces of formwork which face concrete, which will be exposed to view are to be coated with protective form coating to minimize transfer of wood grain to finished concrete.
- .6 Clean formwork in accordance with CSA-A23.1 before placing concrete.
- .7 Re-use of formwork is subject to requirements of CSA-A23.1.
- .8 When forms are stripped during the curing period, cure and protect the exposed concrete.
- .9 Movement and displacement of formwork during construction, variations in excess of specified tolerances and marked and disfigured surfaces that cannot be repaired by specified methods will be considered defective work performed by this Section.
- .10 Reconstruct defective formwork and replace concrete and reinforcement placed in defective formwork at no additional cost to the Owner.

3.3 INSERTS

- .1 Co-ordinate and verify that the Electrical Contractor has set all ducts, boxes and other inserts and openings as indicated or specified elsewhere. Sleeves and openings greater than 100 x 100 mm not indicated on structural or civil drawings must be approved by the Consultant.
- .2 Co-ordinate and verify that the Mechanical Contractor has set all floor drains, cleanouts, trench drains to provide a smooth, flush appearance with the 'FINISHED FLOOR SURFACE' and to ensure a positive and uniform slope towards the drains.
- .3 Do not eliminate or displace reinforcement to accommodate inserts or hardware. If inserts cannot be located as specified, obtain approval of all modifications from the Consultant before placing of concrete.
- .4 Set anchor bolts to templates under supervision of appropriate trade prior to placing concrete. With the Consultant's approval, grout anchor bolts in preformed holes or holes drilled after concrete has set. Formed holes to be at least 100 mm in diameter. Drilled holes to be minimum 25 mm larger in diameter than bolts used. Protect anchor bolt holes from water accumulations. Set bolts and fill holes with non-shrink grout or

epoxy (as noted on drawings).

3.4 GROUTING

- .1 Grout underside of steel column bearing plates with non-shrinking grout to manufacturer's instructions. Place grout to cover steel shims left in place.

3.5 CURING AND PROTECTION

- .1 Cure and protect newly finished slabs and steps in accordance with CSA A23.1 04.
- .2 Coat exterior slabs, curbs with curing compound and leave for 30 days. Apply sealer after curing period has expired.
- .3 Cure finished concrete surfaces in a manner which will leave the surface with a uniform appearance and with a minimum of discolouration after drying. Ensure that curing compounds are compatible with adhesives for finishes to be applied later.
- .4 For all concrete slabs that are to remain exposed, curing compound is to be applied at a rate required for use as a sealer/hardener, in accordance with the manufacturer's instructions.

3.6 FIELD QUALITY CONTROL

- .1 Inspection and testing of concrete and concrete materials will be carried out by a Testing Laboratory designated by the Consultant in accordance with CSA-A23.1.
- .2 The Consultant will take additional test cylinders during cold weather concreting. Cure cylinders on job site under same conditions as concrete which they represent.
- .3 Inspection or testing by Consultant will not augment or replace contractor quality control nor relieve him of his contractual responsibility.

3.7 TOLERANCES

- .1 Cast-in-Place concrete shall be constructed within the dimensional tolerances specified in CSA-A23.1, as specified elsewhere in this section. Concrete floor slabs shall be constructed as moderately flat slabs and within the tolerances listed below.
- .2 Conform in line, level and plumbness to the following tolerances. These are maximum values.
- .3 Variation from vertical, in lines and surfaces of walls piers:

In height of 3m (10')	-	6mm (1/4")
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- .4 Variation from level or from grades shown in floors grade:

In any 3m (10')	-	3mm (1/8")
In any bay up to 6m (20')	-	6mm (1/4")
In any 12m (40')	-	12mm (1/2")
- .5 Variation from straight or from correct position in walls:

In length up to 6m (20')	-	12mm (1/2")
In any 12m (40')	-	12mm (1/2")

- | | | | |
|-----|----------------------------------------------------------------------------------------------------------------------|---|-------------|
| .6 | Variation in size and location of sleeves, floor open and the like and in location of bolts, inserts and fastenings: | - | 6mm (1/4") |
| .7 | Variation in location of bolts, inserts, sleeves and fastenings when in group: | - | 3mm (1/8") |
| .8 | Variation in cross-section of slabs, walls and piers: | | |
| | Maximum oversize | - | 12mm (1/2") |
| | Maximum undersize | - | 6mm (1/4") |
| .9 | There shall be no variations from required level at junction of walls and floors. | | |
| .10 | Where drains occur, floors shall be properly and uniformly sloped to allow complete drainage of the area. | | |

3.8 DEFECTIVE CONCRETE

- .1 Concrete is defective when:
 - .1 Containing visible honeycombing or embedded debris.
 - .2 Concrete damaged by freezing or which is unsatisfactory due to placement at too high a temperature.
 - .3 Average 28-day strength of any three consecutive strength tests is less than specified minimum 28-day strength.
 - .4 Any 28-day strength test result in less than 88% of specified minimum 28-day strength.
 - .5 Cracking occurs in locations other than at control and construction joints.
 - .6 Curing is not carried out strictly according to the specifications.
- .2 Remove and reconstruct in entirety any defective concrete footing, slabs, walls as directed by the Consultant.

3.9 COLD WEATHER PROTECTION

- .1 Refer to CSA Standards CSA-A23.1 and CSA-A23.2 Provisions and Publications. Include for tarped heated enclosures - no non-freeze additives such as calcium will be tolerated on this project.

END OF SECTION

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 - 1.1 GENERAL REQUIREMENTS 1
 - 1.2 WORK IN OTHER SECTIONS 1
 - 1.3 REFERENCE STANDARDS 1
 - 1.4 SOURCE QUALITY CONTROL 1
 - 1.5 DESIGN OF DETAILS AND CONNECTIONS 1
 - 1.6 SHOP DRAWINGS 2
 - 1.7 STORAGE AND HANDLING 2
 - 1.8 EXAMINATION 2
 - 1.9 QUANTITY OF ITEMS 2

- PART 2 - PRODUCTS 3
 - 2.1 MATERIALS 3

- PART 3 - EXECUTION 3
 - 3.1 INSPECTION AND CO-ORDINATION 3
 - 3.2 FABRICATION 3
 - 3.3 ERECTION 4

PART 1 - GENERAL

1.1 GENERAL REQUIREMENTS

- .1 Division 1, General Requirements, is a part of this Section and shall apply as if repeated here.

1.2 WORK IN OTHER SECTIONS

- .1 Related Work Specified in Other Sections

Section 03 30 00	:	Cast-in-Place Concrete
Section 04 20 00	:	Unit Masonry
Section 05 50 00	:	Metal Fabrications
Division 15	:	Mechanical
Division 16	:	Electrical

- .2 Products Supplied Under Work of This Section and Installed Under Work of Other Sections

Section 03 30 00	:	To install anchor bolts and loose bearings plates
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1.3 REFERENCE STANDARDS

CSA S16-14: Design of Steel Structures
CSA W59-13: Welded Steel Construction (Metal Arc Welding)
CSA G40.20-13: General Requirements for Rolled or Welded Structural Quality Steel
G40.21-13: Structural Quality Steel
CSA W48-06 (R2011): Filler Metals and Allied Materials for Metal Arc Welding
CAN/CSA G164-M92 (R2003): Hot Dip Galvanizing of Irregularly Shaped Articles
ASTM F3125/F3125M-15a: Standard Specification for Structural Bolts, Steel, Heat Treated 830 MPa Minimum Tensile Strength
The Ontario Building Code, (O. Reg. 332/12)

1.4 SOURCE QUALITY CONTROL

- .1 Submit 2 certified copies of mill reports covering chemical and physical properties of steel used in this work.
- .2 Submit affidavits from the manufacturer or fabricator that materials supplied comply with this Specification.
- .3 The Owner will appoint an independent inspection and testing company to ensure that the Work of this Section is performed in accordance with the Specifications. The cost of all inspections/testing shall be paid for from the cash allowance allocated for this in Section 01050 - Allowances.

1.5 DESIGN OF DETAILS AND CONNECTIONS

- .1 Design details and connections in accordance with requirements of CAN/CSA-S16, latest edition, to resist forces, moments and shears indicated.

- .2 For non-standard connections, submit sketches and design calculations stamped and signed by qualified professional Engineer registered in the Province of Ontario.
- .3 For standard connections, select details from CISC Handbook of Steel Construction to ensure structural adequacy.
- .4 Submit shop fabrication details stamped and signed by a qualified professional licensed in the Province of Ontario.

1.6 SHOP DRAWINGS

- .1 Submit shop drawings in accordance with Section 01 33 00 Submittals.
- .2 Indicate shop and erection details including cuts, copes, connections, holes, bolts and welds. Indicate welds by welding symbols defined in CSA-W59-13.
- .3 Submit copy of erection drawings to the Consultant for review and reference.
- .4 Submit all weld procedures pertinent to the work prior to or along with the first submission of shop drawings, for subsequent review and acceptance by the Consultant.

1.7 STORAGE AND HANDLING

- .1 Handle all materials with the necessary care to prevent damage to fittings, finishes and alignments.
- .2 Materials damaged due to faulty storage or handling shall be repaired or replaced, without additional expense to the Owner, all to the satisfaction of the Consultant.
- .3 Replace promptly all items verified as received in a damaged condition.

1.8 EXAMINATION

- .1 Examine surfaces with which Work is to be anchored or connected.
- .2 Report to the Consultant, all unsatisfactory conditions likely to prevent or prejudice the proper installation of the work.
- .3 Commencement of Work implies unconditional acceptance of substrate and surface and condition to which all members are to be anchored and secured.

1.9 QUANTITY OF ITEMS

- .1 Where a component, device, item or part of material is referred to in the singular number, such reference shall mean as many as are required to complete the work.

PART 2 - PRODUCTS

2.1 MATERIALS

- .1 Structural steel: to CAN/CSA-G40.21 Grade 350W for rolled sections and plates, Grade 350W for Hollow Structural sections.
- .2 Anchor bolts: to CAN/CSA-G40.21, Grade 300W.
- .3 Bolts, nuts and washers: to ASTM A325M.
- .4 Welding materials: to CSA W48 Series.
- .5 Hot dip galvanizing: galvanize steel, where indicated, to CAN/CSA G164, minimum zinc coating of 600 g/m².

PART 3 - EXECUTION

3.1 INSPECTION AND CO-ORDINATION

- .1 The Contractor shall field check all dimensions and elevations affecting his trade at the site. All discrepancies shall be reported to the Consultant before proceeding with the work.
- .2 The Contractor shall report in writing all defects in the work prepared under other sections of the Specifications which will affect the work of this Section. Commencement of the work will imply acceptance of previously prepared work.
- .3 Verify all requirements and dimensions of existing, proceeding and following Work before commencing fabrication.

3.2 FABRICATION

- .1 Fabricate structural steel, as indicated, in accordance with CAN/CSA-S16 and in accordance only with reviewed and stamped shop drawings.
- .2 Supply fastenings, anchors and accessories required for fabrication and erection of Work. Make exposed metal fastenings and accessories of same material, texture, colour and finish as base metal on which they occur unless otherwise shown or specified. Keep exposed fastenings to absolute minimum and inconspicuous, spacing them evenly and setting them out neatly. Make fastenings of permanent type.
- .3 Beams shall be rolled sections, combined as noted. Beam connections shall be standard double angle clip type, developing full strength of all the members.
- .4 Clean all steel members by scraping, wire brushing or other effective means to remove loose mill scale, rust, oil or other foreign matter. Surfaces shall be thoroughly dry before painting.
- .5 All steel shall be hot dip galvanized.

- .6 All members shall be assembled true and without twists or open joints. Shop connections shall be welded.
- .7 High tensile bolted connections, where used, shall be in accordance with CAN/CSA-S16 latest edition. Holes shall be accurately spaced and of size to allow insertion of bolts of 1.5 mm (1/16") diameter less than hole diameter.
- .8 Welding shall be executed so as to avoid damage or distortion to the work. Welds on exterior work shall be continuous to provide proper weathering; all welds on exposed finished work shall be ground smooth.
- .9 There shall be no burning of holes in members in the shop or field without the permission of the Consultant. If consent is given, burned members shall be finished to an acceptable appearance.
- .10 Mark materials in accordance with CAN/CSA-G40. Do not use die stamping. If steel is to be left in unpainted condition, place marking at locations not visible from exterior after erection. Shop mark bearing assemblies and splices for fit and match.

3.3 ERECTION

- .1 Erect structural steel as indicated in accordance with CAN/CSA-S16 latest edition and in accordance with shop drawings.
- .2 Continuously seal members by continuous welds where indicated. Grind smooth.
- .3 Obtain written permission of the Consultant prior to field cutting or altering of structural members.
- .4 Touch up galvanizing to bolts, rivets, welds and burned or scratched surfaces at completion of erection.
- .5 Erection of structural steel on site shall be properly co-ordinated by the Contractor with the work of all other trades. Co-ordinate the work to incorporate all electrical appurtenances and protect same from damage during erection.
- .6 Bolted assemblies for base connections shall not be tightened until at least 72 hours after the grout pad has been placed.
- .7 All bolts shall be tightened by using a suitable torque wrench, torquing as required in CAN/CSA-S16 latest edition.
- .8 Damaged work will not be accepted on site. Damaged work arriving on site will be returned to the shop for repair and/or refinishing.
- .9 All temporary supports shall be attached to the work in such a manner so as not to mar the surface on the finished section.
- .10 All steel shall be set accurately to the lines and elevations shown on the Drawings.

- .11 Assume full responsibility for the correct plumbing, alignment and setting of all members; set all guys, braces, etc., necessary to maintain the structure during erection, and until such time as the work of other trades is in place.

END OF SECTION

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PART 1 - GENERAL

1.1 GENERAL REQUIREMENTS

- .1 Division 1, General Requirements, is a part of this Section and shall apply as if repeated here.

1.2 WORK IN OTHER SECTIONS

- .1 Related Work Specified in Other Sections
 - Section 03 30 00 : Cast-in-Place Concrete
 - Section 05 12 00 : Structural Metal Framing
- .2 Products Supplied Under Work of This Section and Installed Under Work of Other Sections
 - Section 03 30 00 : To install anchors, bolts and inserts

1.3 REFERENCE STANDARDS

CSA S16-09: Design of Steel Structures
CSA W59-03 (R2008): Welded Steel Construction (Metal Arc Welding)
G40.20-04: General Requirements for Rolled or Welded Structural Quality Steel
G40.21-04 (R2009): Structural Quality Steel
CSA W47.1-09: Certification of Companies for Fusion Welding of Steel
W48-06: Filler Metals and Allied Materials for Metal Arc Welding
CAN/CSA G164-M92 (R2003): Hot Dip Galvanizing of Irregularly Shaped Articles
The Ontario Building Code, (O. Reg. 350/06)

1.4 QUALIFICATIONS

- .1 Execute the work of this Section only by a Subcontractor who has adequate plant, equipment and skilled tradesmen, and is known to have been responsible for satisfactory work similar to that specified during a period of at least five years.

1.5 SHOP DRAWINGS

- .1 Submit shop drawings in accordance with Section 01 33 00 – Submittal Procedures.
- .2 Indicate connections, details, dimensions, and all other data as required to accommodate installation.

1.6 PRODUCT HANDLING

- .1 Deliver materials as required for erection. If storage becomes necessary stack materials on wood blocking clear of ground and tilted slightly so as to avoid water lying on the material. Storage area to be as close to the building as is practical. Protect finished surfaces from damage or rust.
- .2 Damaged materials shall be replaced by this Contractor without extra cost to the Owner.

PART 2 - PRODUCTS

2.1 MATERIALS

- .1 Steel Sections and Plates: to CAN/CSA-G40.21, Grade 350W.
- .2 Hollow Structural Sections: to CAN/CSA-G40.21 Grade 350W.
- .3 Welded Wire Fabric: WWF 50 x 50 x MW11.1 x MW11.1.
- .4 Welding Materials: to CSA W48 Series.
- .5 Hot rolled structural steel shapes: to CAN/CSA-G40.21, Grade 350W.
- .6 Galvanizing: hot dipped galvanizing with zinc coating 600 g/m² to CAN/CSA-G164-M92.
- .7 Stainless Steel: bars and rods to ASI Type 316, No. 4 finish.
- .8 Anchors: strap type or approved self drilling type minimum 3 per member.
- .9 Fasteners: as shown on drawings and as required for secure anchorage.

PART 3 - EXECUTION

3.1 FABRICATION

- .1 The jointing in built-up sections shall be made with hairline joints in the least conspicuous location and manner. All work shall be assembled in the most substantial manner and reinforced where necessary with similar fastenings. All screws shall be countersunk unless otherwise noted.
- .2 Provide positive anchorage to the building structure by means of through bolts, welding, or approved inserts cast into the building structure.
- .3 All metal fabrications to be hot dip galvanized. Touch up any galvanized surfaces damaged after erection with galvafruid paint as approved by the Consultant.
- .4 All items shall be fabricated, finished and assembled in the shop as much as possible, consistent with the size and shipping problems. Assembly on the job shall be kept to a minimum.
- .5 All welds, unless noted specifically otherwise, are to be continuous where exposed and ground smooth.

3.2 SCHEDULE OF FABRICATION

- .1 Generally: Ensure that all Drawings and Specification Sections, including those for architectural, structural, mechanical and electrical work, are consulted to establish the limits of work included in this Section.

- .2 Columns, Plates and Anchor Bolts:
 - : Steel of sizes shown on structural drawings, details.
 - : Finish: galvanized.

- .3 Miscellaneous Channels and Clip Angles:
 - : Provide all miscellaneous fastenings required, including supports, anchor bolts and other items as required and indicated to complete all work as part of this project.
 - : Finish: galvanized.

- .4 Fixed Steel Bollards:
 - : Schedule 40 steel pipe, quantity, sizes and lengths as detailed on the drawings.
 - : Finish: galvanized.

- .5 Handrail at platform level:
 - : 38mm dia. steel pipe, connection plates to be per drawings.
 - : Finish: galvanized.

- .6 Sump Pit Covers and Frames:
 - : As detailed on drawings.
 - : Finish: galvanized.

- .7 Access Ladder:
 - : Steel bar, quantities, sizes and lengths as detailed on drawings.
 - : Finish: galvanized.

- .8 Mezzanine Grating:
 - : As detailed on drawings and in locations shown.
 - : Construct at the discretion of the fabricator and as detailed on the drawings for entire assembly to support not less than 3.6kN/m² live load and to provide clearances as required in accordance with the Ontario Building Code.
 - : Supply all miscellaneous structural supports, bearing and anchorage as required for a complete installation.
 - : Finish: galvanized.

- .9 Anchors and Fasteners:
 - : Provide as shown all anchors either welded to components or supplied loose for securing all items noted in this Section.

3.3 ERECTION

- .1 Erect work in accordance with shop drawings and in co-ordination with trades whose work relates to this Section.
- .2 Erect work plumb, straight, square and accurately fitted with tight joints at intersections.
- .3 Where possible install work in one continuous piece.
- .4 Anchor all components to structure, walls, floors as required with weld or other methods of anchorage approved by the Consultant.

3.4 TOUCH-UP AND REPLACEMENT

- .1 Touch up adjacent galvanized surfaces burned, scratched or otherwise damaged during erection with galvafroid when erection is completed.
- .2 Paint over bare areas on galvanized surfaces and welds with zinc rich paint.
- .3 Replace damaged or unacceptable materials indicated by the Consultants.

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PART 1 - GENERAL

1.1. WORK INCLUDED

- .1 These Specifications are an integral part of the Contract Documents. Tendering and Contract Requirements, General Requirements apply to all Division 20 Specification Sections.
- .2 Work in the Specifications is divided into descriptive Sections which are not intended to delegate functions or work to any specific Subcontractor or identify absolute contractual limits between Subcontractor, nor between the Contractor and his Subcontractor. The requirements of any one Section apply to all other Sections, for example: the motor service factor requirement. Refer to other Divisions and Sections to ensure a completed operational product and fully coordinated standard of work.
- .3 The direction to 'provide' equipment, materials, products, labour and services shall be interpreted to 'supply, install and test' the Division 20 work indicated on the Drawings and specified in the Specifications.
- .4 Provide and include in the Contract Price Division 20 work including mechanical components and normal system accessories not shown on the Drawings or stipulated in the Specifications and required to ensure completed operational systems and a fully coordinated standard of Work acceptable to the Consultant and all authorities having jurisdiction.

1.2. INTENT /PHASING

- .1 Mention in the Specifications or the indication on the Drawings of equipment, materials, operation and methods, requires provision of the quality noted, the quantity required, and the systems complete in every respect.
- .2 Consider the Specifications as an integral part of the accompanying Drawings. Any item or subject omitted from one or the other, but which is either mentioned or reasonably implied, shall be considered as properly and sufficiently specified.
- .3 Where there is apparent contradiction or ambiguity in the documents, or where there are apparent discrepancies in or omissions from the documents, or if there is any doubt as to the intent of the documents, the bidder shall request and obtain written clarification(s) from the Consultant prior to submitting a tender. Consideration will not be granted for misunderstanding of the intent of the documents or the extent of the work to be performed.
- .4 Be completely responsible for the acceptable condition and operation of all systems, equipment and components forming part of the installation or directly associated with it. Promptly replace defective materials, equipment and parts of equipment and repair related damages.
- .5 Phasing shall be scheduled with the Owner.

1.3. METRIC PRACTICE

- .1 Conform to Canadian Metric Practice Guide CSA CAN3-Z234.1-89.
- .2 Provide adapters between metric and imperial installations.
- .3 Metric descriptions in this Division are nominal equivalents of Imperial values.

1.4. COORDINATION

- .1 Coordinate and schedule Division 20 work with all other work in the same area or with work which is dependent upon Division 20 work so as to facilitate mutual progress.
- .2 Identify and resolve interference problems prior to prefabrication and installation of equipment. Submit interference drawings for review upon Consultant Request.
- .3 Examine the site and all Contract Documents prior to bid submission. No allowance will be made for any difficulties encountered due to any features of the building, methods of construction, site or surrounding public and private property which existed up to the bid close.

1.5. REFERENCE STANDARDS

- .1 Provide new materials and equipment of proven design and quality. Provide current models of equipment manufactured in Canada or the United States, unless specified otherwise, with published ratings certified by recognized North American testing and standards agencies.
- .2 Select Canadian made materials and equipment and other equipment to maximize the Canadian content of the Work.
- .3 Workmanship and installation methods shall conform to the best modern practice. Employ skilled tradesmen to perform work under the direct supervision of fully qualified personnel.
- .4 Install equipment in strict accordance with manufacturers written recommendations.
- .5 Meet the additional selection, sizing and performance criteria specified in this Specification.

1.6. DRAWINGS AND MEASUREMENTS

- .1 Drawings show general design and arrangement of mechanical system installation, and are diagrammatic. Obtain further clarification of Drawings or Specifications from Consultant prior to installation.
- .2 Drawings do not indicate exact Architectural, Structural or Electrical features. Examine Drawings prior to laying out.
- .3 Do not scale Drawings to order materials. Take field measurements before ordering and fabricating materials.
- .4 Clarify 'roughing-in' requirements of equipment which is not part of Division 20 work before proceeding.

1.7. REGULATORY REQUIREMENTS

- .1 Meet the requirements and recommendations of all Municipal, Provincial and Federal Bylaws and Ordinances.
- .2 Do not reduce the quality of work specified and/or shown on the Drawings because of regulatory requirements.
- .3 In general, and as applicable, the physical and chemical properties, the characteristics and the performance of Division 20 work shall meet the requirements of recognized agencies including those listed herein:

AMCA	-	Air Moving & Conditioning Association
ADC	-	Air Diffusion Council
ANSI	-	American National Standards Institute
ARI	-	Air Conditioning & Refrigeration Institute
ASHRAE	-	American Society of Heating, Refrigeration and Air Conditioning Engineers
ASME	-	American Society of Mechanical Engineers
ASTM	-	American Society for Testing and Materials
AWWA	-	American Water Works Association
CGA	-	Canadian Gas Association
CGC	-	Consumers Gas Company
CGSB	-	Canadian General Standards Board
CIRI	-	Canadian Industrial Risk Insurers
CSA	-	Canadian Standards Association
CTI	-	Cooling Tower Institute
FCC	-	Federal Communication Commission
FM	-	Factory Mutual
IAO	-	Insurers Advisory Organization
MMC	-	Marsh McLennan Insurance Protection Consultants
MTC	-	Ministry of Transportation and Communication
NBCC	-	National Building Code of Canada
NFPA	-	National Fire Protection Association
OBC	-	Provincial Ontario Building Code
OFM	-	Local Fire Codes or Standards Ontario Fire Marshall
OH	-	Ontario Hydro Special Inspection Department
OME	-	Ontario Ministry of Environment
OML	-	Ministry of Labour and Workmen's Compensation Requirements
OWRA	-	Ontario Plumbing Code
TBD	-	Local Building Codes City of Toronto, Buildings Department
UL	-	Underwriter's Laboratories Inc.
ULC	-	Underwriter's Laboratories of Canada

- .4 Give all necessary notices, obtain all permits and pay for all governmental fees, taxes and other costs in connection with the work. File all necessary Contract Documents, prepare submissions and obtain approvals of regulatory bodies having jurisdiction.

1.8. CHANGES TO CONTRACT WORK

- .1 Do not proceed with any changes to the Work without written authority from the Owner.
- .2 Follow procedures outlined in Tendering and Contract Requirements for administration and execution of Contract revisions.
- .3 Quotations for changes to Division 20 work shall be based on the actual cost of the work:
- .1 For Equipment - The latest edition of the R.S Means, including all applicable discounts or actual invoices where costs are not published.
- .2 For Labour Rates –
- .1 The Mechanical Contractors of America (MCA) published rates, Latest Edition, and as modified by negotiations.

- .2 SMACNA.
- .3 National Electrical Contractors Estimating Manual.
- .3 Markup for overhead and profit as defined in the Contract General Conditions.
- .4 Where changes are extensive, or where requested by the Consultant, material and labour take-off shall be organized on a drawing by drawing basis, or area by area basis to more readily facilitate verification of quantities and labour hours.

1.9. PREPURCHASED EQUIPMENT

- .1 Where equipment has been prepurchased by the Owner for installation by Division 20, assume complete responsibility for acceptance, delivery schedule, off loading, storage, rigging, installation, protection, startup and warranty of this equipment, all as if the equipment were provided by Division 20.
- .2 The responsibilities of the equipment supplier are delineated in the prepurchase documents which are available for Contractor review during the bid period.
- .3 The following equipment has been pretendered in order to ensure equipment delivery in time to meet the building construction schedule.
- .4 Include in Contract Price, the cost of the following prepurchased equipment.
- .5 Exclude the cost of other prepurchased mechanical equipment from the Contract Price.
- .6 The Owner shall bear the equipment and FOB job site shipping costs directly.
- .7 Request from the Owner, full details of the equipment and the manufacturer's Shop Drawings. Include related information in the Operating and Maintenance Manual.
- .8 Assume extensions of warranties to meet specified times.

1.10. WARRANTY

- .1 Meet the requirements of Tendering and Contract Requirements.
- .2 Unconditionally warrant all equipment, material and workmanship for not less than one year from date of Substantial Performance of the Work, or for longer periods when stated elsewhere in the Specifications.
- .3 If any equipment or material does not match the manufacturer's published data or specially supplied rating schedules during performance tests, replace without delay the defective equipment or material. Bear all associated costs of replacement without charge to the Owner. Adjust all components to achieve the proper ratings.
- .4 The Owner will give notice of observed defects promptly in writing.
- .5 Promptly correct defects and deficiencies which originate during the warranty period. Pay for resulting damage.

1.11. INSTRUCTIONS TO BIDDERS

- .1 The Bidder is invited to submit additional alternative prices not specifically requested with the Bid.
- .2 Alternative prices may be used to establish the lowest Contract Price.
- .3 The lowest or any Bid will not necessarily be accepted.

PART 2 - SUBMITTALS

2.1. SHOP DRAWINGS

- .1 Submit one (1) electronic copies of shop drawings for Consultant review. One (1) copy will be returned to the General Contractor bearing comments. Include all cost for reproduction of sufficient copies of reviewed shop drawings for manuals, site forces and coordination among other trades. Where submissions are not readily reproducible in photocopy form, provide mylor/vellum copy in addition to two (2) prints.
- .2 Identify Shop Drawing by Specification index reference and project name.
- .3 Review all Shop Drawings prior to submittal and clearly certify as 'Correct for Review by Consultant'. Show company name, date and sign all Shop Drawings.
- .4 Consultant review of Shop Drawings does not relieve the Contractor of full responsibility for errors, necessity to check Shop Drawings, furnish materials and equipment and perform work required by the Contract Documents.
- .5 Clearly identify all components, accessories, including options to be supplied with each item.
- .6 Submitted product data shall include sufficient detail to allow a reasonable assessment of the equipment being provided. The data shall include, but not be limited to:
 - .1 dimensions, including service clearance requirements
 - .2 design and working pressure ratings of pressure vessels and line components
 - .3 shipping and operating weight including accessories and working fluids, together with point loadings
 - .4 performance specifications including pump and fan curves/charts
 - .5 part load operational capabilities and limitations
 - .6 sound power levels
 - .7 materials of construction including exterior and internal finishes
 - .8 factory test standards rating conformance to recognized and applicable industry standards
 - .9 extended warranty coverage
 - .10 electrical requirements, including complete wiring diagrams clearly defining field, internal and factory wiring scope

- .11 motor, power or control wiring requirements including rated voltage, phase and cycle, rated power draw, full load current, motor size and speed, motor frame size, type of enclosure and maximum rated temperature rise
- .12 product installation, startup and operation manuals
- .13 statement of compliance with the Model National Energy Code of Canada, as applicable.
- .7 Incomplete submissions will be returned as unacceptable.
- .8 Bind one set of reviewed Shop Drawings in each Operating and Maintenance Manual.
- .9 Provide shop drawings for specified items as follows:

Section	Title	Equipment
20 05 00	Basic Mechanical Materials and Methods	Anchors Hangers
20 09 00	Motors, Starters, Control Centres & Wiring	Loose Starters VFD Rated Motor Starters Motor Control Centres
20 09 50	Variable Speed Drives	Variable Speed Drives
20 50 00	Site Utilities	Piping and Valves
22 11 00	Plumbing and Drainage Piping Systems	Valves Balancing Valves Pipe Couplings
22 13 29	Bilge and Sewage Pumps	Sewage Pumps Bilge Pumps Submersible Pumps Starters/Controllers Alarms
25 50 00	Automatic Controls	Control Systems Sequences Control Schematics

2.2. ALTERNATIVE MANUFACTURER AND SUPPLIER

- .1 Equipment and materials are specifically described for the purpose of indicating standards of quality and workmanship. Base Bid on the items specified and shown on Drawings.
- .2 Maximize the Canadian content of all equipment and materials used on this project.
- .3 Alternatives for equipment or materials considered equal in quality and performance may be submitted with the Bid Form. Supply with each alternative, following bid submission, upon request by Consultant, the following information:
 - .1 details of manufacture

- .2 dimensions including required clearance
- .3 performance data
- .4 the cost saving for piping, ductwork and electrical changes imposed by the alternative
- .5 the effect upon and estimated cost to other trades
- .6 Canadian content percentage
- .4 Where alternatives are accepted, there will be no further cost allowances for subsequent changes in Division 20 work or other Contracts to make the alternative complete and equal to the specified equipment and materials.
- .5 The right is reserved to accept or reject any alternative.

2.3. RECORD DRAWINGS

- .1 Suitably store and protect drawings on site and make available at all times for inspection.
- .2 Record inverts of underground piping at building entry/exit and below floor slab at each branch, riser base, change in direction as well as at least three points on straight runs.
- .3 Show locations of access doors and panels and identify the equipment and components that they serve.

2.4. OPERATING AND MAINTENANCE MANUALS

- .1 Submit one copy for review at least two weeks before instructions to Owner are commenced.
- .2 Submit two copies of final manuals to the consultant.
- .3 Ensure that the terminology used in various sections of the manual is consistent.
- .4 Each manual shall contain the following information:
 - .1 description of each system with description of each major component of system
 - .2 complete sets of page size equipment Shop Drawings
 - .3 equipment manufacturer's installation, startup and operation manuals
 - .4 equipment manufacturer's recommended spare parts lists
 - .5 equipment wiring diagrams
 - .6 lubrication schedule for all equipment
 - .7 equipment identification list with serial numbers
 - .8 page size valve tag schedule and flow diagrams
 - .9 final balancing reports
 - .10 water treatment procedure and tests

- .11 control drawings, sequences of operation
- .12 extended warranty documentation if applicable

PART 3 - EXECUTION

3.1. INSPECTION, TESTING AND CERTIFICATES

- .1 Periodic inspections of the work in progress will be made to check general conformity of the work to the Contract Documents. Observed deficiencies will be reported. Correct deficiencies immediately.
- .2 Meet the requirements of all laws, bylaws, codes, regulations and authorities having jurisdiction.
- .3 Where the Contract Documents, instructions or the governing authorities require Division 20 work to be tested, inspected or approved, give sufficient notice of its readiness for inspection and schedule the date and time for such inspection.
- .4 Uncover Division 20 work that is covered up without consent, upon Consultant request, for examination and restore at no extra cost to the Owner.
- .5 Furnish certificates and evidence that Division 20 work meets the requirements of authorities having jurisdiction.
- .6 Correct deficiencies immediately upon notification.

3.2. TEMPORARY SERVICES

- .1 Provide temporary mechanical services.
- .2 Make connections to temporary power source provided and provide extensions for use by Division 20.
- .3 Perform operations necessary for checking, testing and balancing after written approval is given to start up systems. Ensure that care is taken to protect equipment from damage and to prevent distribution of dust through duct systems.

3.3. CUTTING AND PATCHING

- .1 Give notification in time to Other Contractors of openings required for Division 20 Work. Supply accurate details of location and size. When this requirement is not met, bear the cost of cutting and patching.
- .2 Cutting, patching and restoration of finished work to original condition will be carried out by this Contractors.
- .3 Obtain written Consultant approval before cutting openings through structure.
- .4 Where new work connects with existing and where existing work is altered, cut, patch and restore to match existing work.

3.4. PROTECTION

- .1 Protect all Division 20 work from damage. Keep all equipment dry and clean at all times.

- .2 Cover openings in equipment, pipes, with caps or heavy gauge plastic sheeting until final connections are made.
- .3 Repair any damage caused by improper storage, handling or installation of equipment and materials.
- .4 Protect equipment, pipes and temporary services installed by Division 20 from weather damage.

3.5. COMPLETION

- .1 Remove all debris from inside Division 20 systems and equipment.
- .2 Rectify deficiencies and complete work before submitting request for Substantial Performance inspection.
- .3 Follow manufacturer's written instructions regarding bearing lubrication. Remove grease from pillowblock type bearings and install new grease before equipment is put into operation.
- .4 Check and align all drives to manufacturer's acceptable tolerances.
- .5 Check and align all pumps to manufacturer's acceptable tolerances.
- .6 Remove all temporary protection and covers.
- .7 Remove oil and grease from equipment and bases.
- .8 Leave Division 20 work in as new working order.

3.6. INTERRUPTION OF EXISTING SERVICES

- .1 Arrange, schedule and perform work with minimum disturbance to existing facilities and services.
- .2 Submit a complete schedule of service interruptions and changeovers with approximate dates required, durations and times of day, for approval before proceeding.
- .3 Notify Owner in writing at least 72 hours in advance of planned interruption to existing services.
- .4 Interruption of services must occur at the times and for the duration stipulated by the Owner.
- .5 Keep service interruption duration to an absolute minimum. Carry out all preparatory work, measurements, prefabrication, etc., without interruption of existing services.
- .6 If service interruptions are required by the Owner during the night or on weekends, etc., premium time shall be included in the Contract Price. No extra charges will be allowed at a later date for failure to include same.

3.7. REMOVAL AND REUSE OF EXISTING MATERIALS

- .1 Carry out demolition work in accordance with the Occupational Health and Safety Code.
- .2 Remove existing equipment, services and obstacles where required for refinishing or restoring existing surfaces. Replace same as work progresses.

3.8. PROTECTION OF OWNER'S PREMISES

- .1 Adhere strictly to the Owner's requirements.
- .2 Confer with the Owner concerning schedule, dust and noise control prior to commencing work in or adjacent to existing facilities where such work might affect either those facilities or their occupants.
- .3 Execute work with least possible interference or disturbance to occupants, public and normal use of premises.
- .4 Provide temporary means to maintain security when security has been reduced by Division 20.
- .5 Provide temporary dust screens, barriers, warning signs in locations where renovations and alteration work is adjacent to areas which will be operative during work.
- .6 Drawings indicate approximate locations of known existing underground and above ground facilities. Avoid damage to existing services. Bear cost of repairs and replacements.
- .7 Immediately advise Consultant when unknown services are encountered and await instructions.
- .8 Accept liability for costs incurred by the Owner in repairing and cleaning equipment, etc., resulting from failure to comply with the above requirements.

END OF SECTION

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PART 1 - GENERAL

1.1. WORK INCLUDED

- .1 Provide all labour, materials, products, equipment and services to supply and install the basic mechanical materials indicated on the Drawings and specified in Division 20 of these Specifications.

1.2. IDENTIFICATION OF MECHANICAL SERVICES

- .1 Identify all mechanical services after finish painting is complete.
- .2 Use terminology consistent:
 - .1 with the Drawings and Specifications
 - .2 with the Owner's requirements and standards.
- .3 Mark valve and equipment identification on Record Drawings.

1.3. VALVE TAGS

- .1 Provide {40 mm} [1-1/2"] dia., {1 mm} [0.040"] thick brass tags with {10mm} [3/8"] high die-stamped black letters.
- .2 Attach to valves with {100 mm} [4"] long brass chains.
- .3 Tag all valves except for small valves isolating a single piece of equipment such as a unit heater, fan coil unit, terminal reheat coil and radiation section.

1.4. EQUIPMENT NAMEPLATES

- .1 Identify equipment, starters, and, remote control devices in a manner consistent with the Drawings.
- .2 Use solid black capitalized lettering {100 mm} [4"] high.
- .3 Where equipment size does not permit stencil identification, use lamacoid labels, engraved white on black, mechanically fastened to the equipment. Minimum lettering size {10 mm} [3/8"].

1.5. CONTROLS IDENTIFICATION

- .1 Meet Section 25 50 00 requirements.

PART 2 - PRODUCTS

2.1. INSERTS

- .1 Submit proposed materials and methods for cast-in-place inserts.
- .2 Where inserts must be placed after concrete is poured, use Phillips Red Head Multiset II Anchor system or equivalent Hilti System.

2.2. PIPE HANGERS

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- .1 Provide pipe hangers and supports for all piping. Provide hangers in accordance with the following requirements. Provide steel supports in accordance with the subsequent article in this specification section. Provide galvanized steel hangers and supports with galvanized fittings and accessories where exposed to direct contact with water or to possible high humidity conditions where condensation can occur.
- .2 Provide manufactured hangers, accessories and supports in accordance with ANSI B31.1 and MSS SP58, SP69, SP89 and SP90 similar to the Grinnell or Myatt figures numbers below.
- .3 Select products to ensure adequate safety factors under anticipated loads.
- .4 Provide upper attachments as follows:
 - .1 Standard beam clamp for normal service - Grinnell Fig 133 with Fig 290 or Fig 278 or Myatt Fig 500 with Fig 480 or Fig 440.
 - .2 Standard side beam clamp for normal service - Grinnell Fig 225 or Myatt Fig 505.
 - .3 Top beam clamp - Grinnell Fig 92 or Myatt Fig 406.
 - .4 C clamp - Grinnell Fig 86 or Myatt Fig 586.
 - .5 Angle clip for light duty side mounting - Grinnell Fig 202 or Myatt Fig 542.
- .5 For vertical adjustment of hanger rods, provide forged steel turnbuckle - Grinnell Fig 230 or Myatt Fig 475.
- .6 Provide pipe attachments as follows:
 - .1 Adjustable swivel rings for uninsulated fire service piping - ULC and FM approved - Grinnell Fig 69 or Myatt Fig 41.
 - .2 Clevis hanger for copper piping up to and including {100 mm} [4"] diameter - Grinnell Fig CT-65 plastic coated or Myatt Fig 56 epoxy coated.
 - .3 Swivel ring hanger for copper tubing up to and including {25 mm} [1"] diameter - Myatt Fig 43 epoxy coated.
 - .4 Standard duty clevis hanger for steel piping - Grinnell Fig 260 or Myatt Fig 124.
 - .5 Standard duty long clevis hanger for steel piping - Grinnell Fig 300 or Myatt Fig 124L.
- .7 Provide vertical pipe supports as follows:
 - .1 Riser clamp for copper pipe - Grinnell Fig CT121C plastic coated or Myatt Fig 186 epoxy coated.
 - .2 Riser clamp for steel or cast iron pipe - Grinnell Fig 261 or Myatt Fig 182 or Fig 183.
- .8 Provide supports for other piping types such as plastic, mechanically fused or packed joint pipe according to the pipe manufacturer's published recommendations. Support piping continuously where required to prevent sagging.
- .9 Provide protection saddles where insulated piping is supported from below.

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- .1 For high temperature insulated pipe - Grinnell Fig 160 or Fig 165 or Myatt Fig 210 or Fig 240.
- .2 For insulated pipe with vapour barrier for low temperature service, insulate pipe with calcium silicate at hangers and provide Grinnell Fig 167 or Myatt Fig 251.
- .10 Provide roll type supports where shown on the drawings and where longitudinal movement may occur. Provide single pipe rolls - Grinnell Fig 177 or Myatt Fig 262 where supported from below and Grinnell Fig 171 or Myatt Fig 261 where suspended. Provide spring cushions where slight vertical movement is likely and cushioning required - Grinnell Fig 178 or Myatt Fig 880.
- .11 Provide Grinnell or Myatt engineered constant support hangers on piping subject to vertical movement exceeding {40 mm} [1 1/2"] due to vertical pipe expansion.

2.3. EQUIPMENT RIGGING SUPPORTS

- .1 Provide eyebolts suitable for block and tackle connection, adequately supported by the structure above for:
 - .1 sewage and bilge pumps
 - .2 other equipment which will require block and tackle handling

2.4. SLEEVES, WALL AND FLOOR PLATES

- .1 For pipe sleeves, use machine cut and reamed standard weight steel piping.
- .2 Concealed perimeter risers and runouts may have sleeves of {1.31 mm} [18 gauge] galvanized steel set around section of insulation to provide freedom of movement of piping. Extend {50 mm} [2"] above finished floor level.
- .3 For piping through exterior walls, cooperate with the waterproofing trade at all times, and do not break any waterproofing seal without consent of the waterproofing trade. Provide waterproof link seals as detailed on Drawings.
- .4 Provide leak plates where pipe sleeves pass through exterior building walls. Each leak plate shall be a {3.42 mm} [10 gauge] steel plate, welded to the sleeve, {100 mm} [4"] diameter greater than sleeve outside diameter.

2.5. PROVISION FOR PIPE EXPANSION, CONTRACTION AND BUILDING SHRINKAGE

- .1 Where space limitations do not permit the use of expansion loops or offsets, provide Flexonics Expansion Joints properly selected for system operating pressures according to the following:
 - .1 For piping up to and including {65 mm} [2-1/2"], select ends to suit specified pipe fittings. Pressure shall be external to the bellows. Pressure ratings for Model H and HB expansion compensated as {1400 kPa} [200 psi] and {1050 kPa} [150 psi].
 - .2 Steel Piping - Flexonics Model H expansion compensator with two ply stainless steel bellows.
 - .3 Copper Piping - Flexonics Model HB expansion compensator with two ply bellow, all bronze construction.
 - .4 For piping {75 mm} [3"] and above, use flanged ends.

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- .5 Steel Piping - Flexonics controlled, flexing expansion joint with stainless steel pressure carrier, flanged ends.
- .6 Provide Victaulic 150/155 expansion joints for Victaulic piping systems.
- .7 Submit for Consultant review prior to installation, drawings showing the location of expansion joints, anchors and guides. Show details of proposed connection to structure and loads to be imposed. All Drawings must be signed by a Professional Engineer registered in the Province of Ontario.

2.6. COVERS

- .1 Supply frames for installation by Division 3.
- .2 Provide covers for pits and sumps.
- .3 Provide gas tight gaskets for sewage pits.
- .4 Trench gratings will be provided by Division 5 - Metals.

2.7. WELDING AND BRAZING

- .1 All welding and brazing shall conform to all rules and regulations which apply in the latest issues of the following codes and standards:
 - .1 Building Services Piping Code ANSI/ASME B 31.9 (latest edition)
 - .2 CSA B51 (latest edition), Boiler, Pressure Vessel and Pressure Piping Code
 - .3 ASME Boiler Code - Section IX
 - .4 All requirements of the Technical Standards and Safety Authority (TSSA)
- .2 Welding shall conform to a welding procedure which must be in accordance with TSSA requirements and include materials, weld preparation, heat treatment and welding equipment to be used.
- .3 Qualify all welders for the project work according to ASME equivalent testing procedures. The contractor shall not use welders, under any circumstances, for on site or off site work which are not qualified for the work performed. Maintain records for all qualification testing, by welder and provide copies to the Consultant on request. Qualification will include welding and examination of test pieces.
- .4 Qualified welders shall be issued with an identification number and a stamp for use in identifying welds performed by an individual welder. Welding work shall be identified using the identification number and the contractor shall maintain identification records.
- .5 Welds shall be full penetration, continuous and without defects. After deposition, each layer of weld shall be cleaned to remove slag and scale by wire brushing or grinding, then chipped where necessary to prepare for proper deposition of the next layer. The weld reinforcement shall not be less than {1.6 mm} [1/16"] and not more than {3.2 mm} [1/8"] above the normal surface of the joined sections. The reinforcement shall be crowned at the centre and shall merge into the base material without excessive shoulder or undercut.

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- .6 Welding shall be made by machine or manual shielded metallic arc process. Direct current shall be used exclusively with the base material on the negative side of the line. Electrodes used shall be an approved all position rod type.
- .7 Provide a copy of TSSA registration and include with Maintenance Manuals.

PART 3 - EXECUTION

3.1. EXCAVATION AND BACKFILL

- .1 Excavation and backfill required for Division 20 work inside the building and to a point {1.5 m} [5 ft] outside building shall be carried out by the Division listed in the following schedule:
 - .1 Excavation:
 - Initial excavation to {150 mm} Division 2 [6"] above pipe inverts
 - .2 Final excavation to pipe inverts Division 20
 - .3 Backfill
 - Initial backfill with sand to Division 20 {300 mm} [12"] above top of pipes
 - .4 Final backfill Division 20
 - .5 Ensure that excavation work is executed to attain required inverts and grades.
- .2 Remove material excavated by Division 20 and not to be reused, from the site.
- .3 Carefully prepare the bottom of pipe trench. Use one of the following bedding methods:
 - .1 In firm undisturbed soil, lay pipe directly on the soil and shape soil to fit the lower 1/3 segment of pipe and fittings.
 - .2 In rock, shale and where noted, excavate to {150 mm} [6"] below and minimum {200 mm} [8"] on each side of pipe. Form a {150 mm} [6"] thick bedding using {10 mm} [3/8"] crushed stone. Provide continuous support over at least the lower 1/3 segment of pipe.
 - .3 In unstable soil, in fill and where soil has been disturbed during previous excavation work, excavate to at least {150 mm} [6"] below bottom of pipe and form a reinforced concrete cradle supporting full length between firm support, or install piers down to undisturbed solid soil. Piers shall be at a maximum spacing of {2400 mm} [8 ft]. Provide at least one pier for each pipe length. Support over at least the lower 1/3 segment of pipe.
- .4 Where excavation is necessary close to and below the level of any footing, backfill with {14,000 kPa} [2000 psi] concrete to the level of the highest adjacent footing. Do not proceed with the work prior to receiving written approval from Consultant.
- .5 Obtain approval from governing authorities and Consultant before backfilling.

3.2. PIPE AND EQUIPMENT INSTALLATION

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- .1 Locate distribution systems, equipment and materials for maximum usable space, optimum service clearances and to accommodate current requirements and identified future expansion.
- .2 Coordinate Division 20 services installation above typical floor modular ceilings to allow installation and future relocation of lights and air troffers without interfering with or requiring relocation of mechanical, electrical or other services, or removal of ceiling grid.
- .3 Include all pipe and duct offsets required to eliminate interference with the work of other Divisions.
- .4 Install equipment and materials to present a neat appearance. Run piping, ducts and conduit parallel to or perpendicular to building planes. Conceal piping, ducts and conduit in finished areas. Install so as to require a minimum amount of furring.
- .5 Install pipe and conduit straight, parallel and close to walls and slab or deck underside, with specified pitch.
- .6 Use standard fittings for all direction changes. Do not use drilled tees and other field fabricated fittings.
- .7 Install eccentric reducers in horizontal piping to permit drainage and eliminate air pockets.
- .8 Where pipe sizes differ from connection sizes of equipment, provide reducing fittings between inline components such as valves, strainers and fittings, and equipment. Reducing bushings are not permitted.
- .9 Cap open ends of piping during installation.
- .10 Lay copper tubing so that it is not in contact with dissimilar metal and will not kink or collapse.
- .11 Use non-corrosive lubricant or teflon tape equal to Dow Corning and apply on male thread.
- .12 Provide brass adaptors or dielectric couplings wherever dissimilar metals are joined.
- .13 No pipe to be laid in water or when, in opinion of Consultant conditions are unsuitable.
- .14 Protect buried copper and steel piping with Tapecoat materials using procedures recommended by Tapecoat Company of Canada Limited, or other approved manufacturer.
- .15 Ensure that pipe installation does not transmit vibration to the walls and floors through which they pass.
- .16 Make provisions for neat insulation finish around equipment and materials. Do not mount equipment within insulation depth.
- .17 In electrical rooms and elevator machine rooms, provide drip trays under the entire length of all pipe within the confines of the room. Pipe drip tray to nearest floor drain.
- .18 Perform pipe welding to meet ANSI B31.9.

3.3. CONNECTIONS TO EQUIPMENT

- .1 Provide unions or flanges at all connections to equipment. Ensure that piping adjacent to equipment is readily removable for servicing and/or removal of equipment without shutting down entire system.

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- .2 Install unions in piping up to and including {50 mm} [2"] pipe size. Install flanges in piping {65 mm} [2-1/2"] pipe size and larger.
- .3 Prevent galvanic corrosion by isolating copper and steel. Use red brass adapters, or completely isolate flanges using full face gaskets with bolts installed through phenolic sleeves with insulating fibre washers. Where the Plumbing Code prohibits the use of red brass adapters, use insulating couplings. Where system valves are required, solid brass isolating valves may be used in lieu of adapters or couplings.
- .4 Provide metallic code rated continuity link between flanges or unions, where pipe mains carry flammable fluids or gases.
- .5 Make all plumbing connections to equipment provided by the Owner.

3.4. HANGERS

- .1 Suspend piping, ductwork and equipment with all necessary hangers and supports required for a safe and neat installation. Ensure that pipes are free to expand and contract and are graded properly. Adjust each hanger to take its full share of the weight.
- .2 Suspend hanger rods directly from the structure. Do not suspend pipes, ducts or equipment from other pipes, ducts, equipment, metal work or ceilings.
- .3 Provide auxiliary structural steel angles, channels and beams where ductwork, piping and equipment must be suspended between joists or beams.
- .4 Use galvanized rods, steel support angles, channels and beams where exposed to direct contact with water or to possible high humidity conditions where condensation can occur.
- .5 Space hangers to ensure that structural steel members are not over stressed. In no case shall pipe hangers be further apart than indicated in the tables. When requested, submit detailed drawings showing locations and magnitude of ductwork, piping and equipment loads on the structure. Provide calculations when requested by Consultant.
- .6 Do not use trapeze type hangers for support of piping, without prior review by Consultant. Where permitted, fabricate from angle or channel frames, and space hangers to suit the smallest pipe size.
- .7 Do not use hooks, chains or straps to support equipment and materials.
- .8 For precast concrete work, if inserts cannot be cast into members, pass hanger rods between the members and weld to steel plates resting on the upper surface of the precast material. To prevent raising of the hanger rod, apply a lock nut and {50 mm} [2"] minimum dia. flat washer tight against the under surface of the precast material.
- .9 Ensure that copper materials are completely isolated from ferrous materials. Use plastic or epoxy coated hangers and clamps. Use lead inserts between copper piping and other ferrous materials.
- .10 Provide round steel threaded rods meeting ASTM A-36. Provide cadmium plated rod and accessories where exposed to direct contact with water or to possible high humidity conditions where condensation can occur.
- .11 The following table establishes minimum standards of rod sizes and hanger spacing for steel and copper piping.

Maximum Horizontal Spacing of Supports			
Pipe Size {mm} [in]	Rod Size {mm} [in]	Steel {m} [ft]	Copper {m} [ft]
{12} [1/2]	{10} [3/8]	{1.5} [05]	{1.5} [05]
{20} [3/4]	{10} [3/8]	{1.8} [06]	{1.8} [06]
{25} [1]	{10} [3/8]	{1.8} [06]	{1.8} [06]
{32} [1-1/4]	{10} [3/8]	{2.4} [08]	{2.1} [07]
{40} [1-1/2]	{10} [3/8]	{2.7} [09]	{2.4} [08]
{50} [2]	{10} [3/8]	{2.7} [09]	{2.7} [09]
{65} [2-1/2]	{12} [1/2]	{3.0} [10]	{3.0} [10]
{75} [3]	{12} [1/2]	{3.0} [10]	{3.0} [10]
{90} [3-1/2]	{12} [1/2]	{3.0} [10]	{3.3} [11]
{100} [4]	{16} [5/8]	{3.0} [10]	{3.7} [12]
{125} [5]	{16} [5/8]	{3.7} [12]	{3.7} [12]
{150} [6]	{20} [3/4]	{3.7} [12]	{3.7} [12]
{200} [8]	{22} [7/8]	{3.7} [12]	
{250} [10]	{22} [7/8]	{3.7} [12]	
{300} [12]	{22} [7/8]	{3.7} [12]	
{350} [14]	{25} [1]	{3.7} [12]	
{400} [16]	{25} [1]	{3.7} [12]	
{450} [18]	{29} [1-1/8]	{3.7} [12]	
{500} [20]	{32} [1-1/4]	{3.7} [12]	
{600} [24]	{32} [1-1/4]	{3.7} [12]	

- .12 For steel pipe sizes larger than {600 mm} [24"], refer to Drawings.
- .13 In addition to these basic requirements, provide hangers in the following location:
 - .1 to eliminate vibration
 - .2 at points of vertical and horizontal change of direction of pipe
 - .3 at valves
 - .4 on mains at branch takeoffs
 - .5 to avoid stress on equipment connections
- .14 Support horizontal cast iron soil pipe at each hub. Where groups of fittings occur, not more than three joints shall be between hangers.

3.5. PAINTING

- .1 On uninsulated iron piping, steel brush and prime.
- .2 Touchup or repaint all surfaces damaged during shipment or installation and leave ready for finish painting.

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- .3 Prime coat material shall conform to Canadian General Standards Board Standard No. 1-GP-48.
- .4 Provide finish painting on all uninsulated iron piping. Coordinate colour with owner

3.6. WELDING AND BRAZING INSPECTION

- .1 Make welding and brazing work for HTHW and high pressure steam available at any time for inspection by the Consultant. Welded joints shall be gamma-ray radiographed by an independent reputable firm specialized in this field, whose appointment shall be subject to the Consultant's approval. Submit the name and qualifications of the proposed firm to the consultant for review. Perform radiography in accordance with CSA Code B51.
 - 1. Seven line joints in piping subject to high working pressure and three in other piping, as selected by the Consultant from the first 50 production welds in each pressure category.
 - 2. Additional joints to a maximum of 1% of all weld joints.
 - 3. Radiograph all above joints over the full circumference.
 - 4. For every failure, two additional joints shall be selected by the Consultant for testing.
- .2 Examine weld preparation and welding on site and off site at various stages of fabrication.
- .3 Radiographs will be interpreted in accordance with CSA Code B51.
- .4 The independent testing firm shall submit written evaluations of all testing.
- .5 Make all radiographic film evidence of tested welds available for examination by the Consultant. Turn over original films for Owner's files.
- .6 Failure of any retests by one welder shall result in examination of that welder's qualifications and test work. Further testing will be required in that welder's work without additional cost to the Contract.
- .7 Any and all welds found to be of poor or doubtful quality shall be cut out and replaced with satisfactory welds at Division 20 expense.
- .8 One or more of the following defects shall be cause for rejection of a weld:
 - .1 failure to meet radiographic requirements or other code tests
 - .2 welding performed by unqualified personnel
 - .3 welds not reasonably uniform in appearance
 - .4 evidence of peeling
 - .5 cracks
 - .6 oxidation around welds
 - .7 lack of fusion
 - .8 the presence of porosity, slag inclusion or overlaps

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- .9 undercutting adjacent to completed welds or evidence of undercutting by grinding
- .9 Maintain full records of all testing and submit copies to the Consultant showing details of each inspection, with the radiograph recording and the name and identification of the welder. Provide the test results within 24 hours of the test.
- .10 Include all costs associated with the specified inspection of welding and brazing.

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PART 1 - GENERAL

1.1. WORK INCLUDED

- .1 Comply with the Agreement between the Construction Manager and Trade Contractor and all other documents referred to therein.
- .2 Provide all services, materials and labour required to fully commission the mechanical systems in accordance with this Section of the Specification.

1.2. COORDINATION

- .1 Meet the requirements of the General Instructions.
- .2 Coordinate the work of this Section with all other Divisions to ensure complete and operational mechanical systems at completion of this work.
- .3 Appoint a single person as Commissioning Coordinator who shall be responsible for progressing the commissioning activities of each Division 20 trade. The Commissioning Coordinator shall report to the Commissioning Manager.
- .4 Review the design intent of the project and the intended operation of systems with the Consultant before proceeding with commissioning.

1.3. QUALITY ASSURANCE

- .1 The commissioning process shall meet the requirements of CAN/CSA Z31 series, the Code of Practice for Commissioning Mechanical Systems in Buildings.
- .2 Division may elect to source startup and handover by a specialist commissioning company. Supply to the Commissioning Manager, the following details regarding the proposed firm:
 - .1 Principle representative and qualifications
 - .2 Proposed personnel and relevant project experience
 - .3 Previous similar assignments and references
 - .4 Scope of work to be undertaken
 - .5 Company resources and equipment
- .3 Use of a commissioning specialist shall not relieve Division 20 of the obligation to name one of his own employees as the person responsible for progressing commissioning, i.e. the Commissioning Coordinator.
- .4 Supply the name, qualifications and experience of the proposed Commissioning Coordinator upon Construction Manager request. Selection shall be subject to review and the approval of the Consultant. Supply alternative person(s) when requested by Consultant.
- .5 The Consultant may, at his discretion, attend and advise in the commissioning process. Meet Consultant requirements.
- .6 Hold and attend regular meetings during the commissioning process. Prepare detailed progress reports to coincide with regular commissioning meetings. Coordinate with the Commissioning Manager, the preparation and issue of minutes for each meeting to be

circulated to each involved trade, the Consultant and the Construction Manager representative(s). Minutes shall highlight action items.

PART 2 - PRODUCTS

2.1. SCHEDULES AND COMPLETION OF INSTALLATION OF SYSTEMS

.1 Submit to the Consultant, 30 days prior to the scheduled Substantial Performance, a detailed and comprehensive installation completion/startup/testing schedule, identifying all trades and suppliers to be involved. Update the schedule and resubmit for review, on a bi-weekly basis, during the course of commissioning. If found to be unacceptable, revise the schedule and the construction forces to suit the reviewed schedule. This schedule shall include, but is not limited to the following items:

- .1 Installation and testing of pipe systems
- .2 Control system wiring
- .3 Electrical service connections (by Electrical Contractor)
- .4 Equipment suppliers prestart checkout of the equipment installations.
- .5 Start up of various pieces of equipment and systems
- .6 Operational testing of system components
- .7 Performance testing of equipment and systems
- .8 Acceptance testing of equipment installations and systems including fire and sprinkler
- .9 Troubleshooting
- .10 Calibration of controls and point checkout.
- .11 Control software setup and checkout including seasonal and response checkout of operating sequences.
- .12 Demonstration of systems and equipment
- .13 Maintenance manual preparation and submittal
- .14 Operator training program
- .15 Record documentation submittal

2.2. RECORD DOCUMENTATION

- .1 Prepare record documentation for each equipment installation covering:
- .1 Equipment identification and supplier
 - .2 Shop Drawing submittal, review, production release, and delivery dates
 - .3 Dates for completion of all work required to prepare for equipment installation
 - .4 Dates for equipment installation, supplier prestart checkout and system availability for startup

- .5 Dates for equipment startup, performance testing, proposal for temporary use, acceptance testing, demonstration, turnover and warranty start/finish
- .2 Submit proposed record sheets and procedures to Consultant for review, when requested by the Owner.
- .3 Provide documentation of the commissioning process for inclusion into the maintenance manuals. These are to include checkout sheets, equipment data sheets, startup certificates from suppliers involved in startup, documentation concerning demonstration to the Owner. Include all records and result sheets from commissioning tests.
- .4 Maintain a log of key operating parameters, problems encountered, solutions employed and verification of effectiveness of solutions. Include log in maintenance manuals.
- .5 Refer to example documentation available from Construction Manager's representative. Meet or exceed this level of reporting.

2.3. STARTUP

- .1 Coordinate and supervise the startup of the various pieces of equipment and systems. Utilize the startup services of the manufacturer's representative. Ensure that the equipment is operating in a satisfactory manner. Check the following items:
 - .1 Direction of rotation
 - .2 Grease and lubricants
 - .3 Noise, if deemed to be a problem
 - .4 Seals
 - .5 Alignment of pump and fan drives by a millwright
 - .6 Piping connections and safeties
 - .7 Electrical amp draw, starting inrush current and trip/heater settings

2.4. OPERATION AND TESTING

- .1 Meet Section 20 04 00 requirements for Inspection, Testing and Certificates.
- .2 Test the operation of the individual components and systems. Go through each step of the sequence of operation and verify that each component operates correctly. Direct and ensure that all trades involved make the required changes and adjustments to effect the proper operation of all components and systems. Meet commissioning test requirements.
- .3 Document operation and testing.
- .4 Carry out operational tests for the current season and simulate operation of summer, winter and intermediate seasons.

2.5. DEMONSTRATION

- .1 Demonstrate to the Owner the proper operation of all equipment and systems supplied under this Division. Demonstrations shall occur only after the operation and testing has been

successfully completed. Ensure that Trade Contractor and equipment suppliers participate in the demonstration as required.

2.6. OPERATING AND MAINTENANCE MANUALS

- .1 Coordinate the manual provision with Consultant prepared Operation and Maintenance Manual, if available.

PART 3 - EXECUTION

3.1. COMMISSIONING TESTS

- .1 Verify readings, calibration and setup of sensors and equipment, including:
 - .1 Ultrasonic sensors
 - .2 Status switches
 - .3 Alarm contacts
- .2 Verify correct sensors are reporting accurately to the distributed field panels and operator workstation.
- .3 Coordinate with Division 26, a power failure test with emergency generator startup.
 - .1 Miscellaneous equipment on emergency power, with Division 26.
 - .2 Stability of control equipment with startup power surge
 - .3 Controls system recovery
- .4 Verify the operation of all other equipment provided by Division 20.
- .5 Verify that interfacing to the work of other Divisions results in complete and operational systems.

3.2. POST SUBSTANTIAL PERFORMANCE VISITS

- .1 Visit the site and the Owner's representative each month after Substantial Performance for a minimum period of two days until the end of the project warranty period.
- .2 Review the operation of the system.
- .3 Correct any operating problems, if problem is related to warranty issues.
- .4 Prepare a report for the Consultant and Construction Manager for inclusion in the Operating Manuals of the problems and issues that have arisen and the corrective action(s) recommended and implemented.

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PART 1 - GENERAL

1.1. WORK INCLUDED

- .1 These Specifications are an integral part of the Contract Documents. Tendering and Contract Requirements and Division 1, General Requirements apply to all Division 20 Specification Sections.
- .2 Provide labour, materials, products, equipment and services required to complete the demolition work specified herein.
- .3 Refer to Drawings for extent of demolition work. The drawings indicate the approximate locations of services as far as these are known.
- .4 Dispose, off site, of all debris in accordance with the jurisdictional authorities.
- .5 Mechanical demolition work associated with this building is indicated on the demolition drawings and generally and consists of the following:
 - .1 Plumbing and Drainage

1.2. REFERENCE STANDARDS

- .1 Meet the requirements and recommendations of all Municipal, Provincial and Federal Bylaws and Ordinances.
- .2 Execute this work in accordance with the latest edition of the following codes and standards.
 - .1 CAN/CSA-S350-M1980 - Code of Practice for Safety in Demolition of Structures.
 - .2 Ontario Building Code.
 - .3 Occupational Health and Safety Act.
 - .4 Regulations for Construction Projects.

1.3. QUALITY ASSURANCE

- .1 All work shall be performed by a firm having adequate equipment and skilled labour and being able to provide written evidence of satisfactorily completed work, similar to that specified during the past immediate five (5) years.
- .2 Removal from site and disposal of debris shall be carried out in accordance with the requirements of the local jurisdictional authorities.
- .3 Arrange and pay for all permits, notices and inspections necessary for the proper execution and completion of the demolition work.

PART 2 - PRODUCTS

2.1. DISPOSAL OF MATERIALS

- .1 All materials which have not been designated for salvage from the demolition shall become the property of the Contractor. Remove all material and debris from the site as quickly as possible and dispose of legally. Burning of debris or selling of materials on the site will not be permitted.

- .2 Present to the Owner existing equipment removed but not identified for salvage on site. Acceptance of removed equipment is at the discretion of the Owner. Remove such items from site when deemed unsuitable.
- .3 Conform to requirements of municipality's Works Department regarding disposal of waste materials.
- .4 Materials prohibited from municipality waste management facilities shall be removed from site and disposed to recycling companies specializing in recyclable materials.

PART 3 - EXECUTION

3.1. GENERAL INSTRUCTIONS

- .1 At the end of each work shift, leave work in a safe condition.
- .2 Demolish work into sections of practical size for removal without alteration or damage to existing building.

3.2. STORAGE OF MATERIALS

- .1 Store materials only in areas designated by the Owner and as permitted by the local jurisdictional authorities.
- .2 Materials and debris shall not be stacked in building to the extent that overloading of any part of the structure will occur.

3.3. PROTECTION OF OWNERS PREMISES

- .1 Adhere strictly to the Owner's requirements.
- .2 Confer with the Owner concerning schedule, dust and noise control prior to commencing work in or adjacent to existing facilities where such work might affect either those facilities or their occupants.
- .3 Execute work with least possible interference or disturbance to occupants, public and normal use of premises.
- .4 Provide temporary means to maintain security when security has been reduced by Division 20.
- .5 Provide temporary dust screens, barriers, warning signs in locations where renovations and alternation work is adjacent to areas which will be operative during work.
- .6 Protect all mechanical systems, indicated to remain, from damage.
- .7 Provide and maintain ready access to fire fighting equipment at all times.
- .8 Provide and maintain proper and suitable fire extinguishers throughout the duration of the work.
- .9 disruption or break, at no expense to the Owner. Notify the Owner immediately whenever any service line is broken or damaged.
- .10 Accept liability for costs incurred by the Owner in repairing and cleaning equipment, etc., resulting from failure to comply with the above requirements.

3.4. RESTRICTIONS ON USE OF PREMISES

- .1 Use only those existing entrances and stairs designated by the Owner for access to and egress from the existing buildings and various floors where work of this contract is to be carried out. No traffic through other areas of the building will be permitted without the prior consent of the Owner.
- .2 Keep stairs and corridors clear and open as required by Fire Marshall for exit purposes in case of fire, and as required for use by the Owner's personnel.
- .3 Owner will designate which toilet facilities may be used.

3.5. PREPARATION

- .1 Notify the consultant a minimum of **48 hours** prior to commencing this work.
- .2 Prior to commencing this work arrange to have the appropriate trades concerned present for the disconnection of all utility services.
- .3 Ensure that all existing services designated to remain are adequately protected.

3.6. TERMINATION OF EXISTING SERVICES

- .1 Arrange and pay for the disconnection, capping and for plugging of sewer and other services to the building to be demolished. In each case the utility company involved shall be notified in advance and its approval obtained before commencing that portion of the work. Disconnect and cap services at the locations indicated by the Consultant.

3.7. INTERRUPTION OF EXISTING SERVICES

- .1 Arrange, schedule and perform work with minimum disturbance to existing facilities and services.
- .2 Submit a complete schedule of service interruptions and changeovers with approximate dates required, durations and times of day, for approval before proceeding.
- .3 Notify Owner in writing at least 72 hours in advance of planned interruption to existing services.
- .4 Interruption of service must occur at the times and for the duration stipulated by the Owner.
- .5 Keep service interruption duration to an absolute minimum. Carry out all preparatory work, measurements, etc., without interruption of existing services.
- .6 If service interruptions are required by the Owner during the night or on weekends, etc., premium time shall be included at the Contract Price. No extra charges will be allowed at a later date for failure to include same.

END OF SECTION

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PART 1 - GENERAL

1.1. WORK INCLUDED

- .1 Comply with Division 1, General Requirements and all documents referred to therein.
- .2 Provide all labour, materials, products, equipment and services to supply and install the plumbing and drainage inside the building to point of connection outside the exterior building wall as indicated on the Drawings and specified in this Section of the Specifications.

PART 2 - PRODUCTS

2.1. PIPE AND FITTINGS

.1 Drainage and Vent Piping:

	Pipe Size {65mm} [2-1/2"] & Smaller	Pipe Size {75mm} [3"] & Larger
Sanitary - Above Ground	Type L copper with 95/5 tin/antimony joints.	CSA Class 4000 cast iron soil pipe and fittings, with mechanical joints.
Vent Piping - Above Ground	DWV copper pipe with drainage fittings, 95/5 tin /antimony solder joints.	CSA Class 4000 cast iron soil pipe and fittings with mechanical joints.

.2 Domestic Water:

.1 Domestic hot water and recirculation - all sizes:

- .1 Type L hard copper pipe, wrought copper fittings with 95/5 tin/antimony solder joints.

.2 Domestic cold water and domestic chilled water all sizes.

- .1 Type L hard copper pipe, wrought copper fittings with 95/5 tin/antimony solder joints.

.3 Bilge and Sewage Pump Discharge Piping:

.1 {65 mm} [2-1/2"] and smaller:

- .1 Type L hard copper, wrought copper fittings with 60/40 lead/tin solder joints.

- .2 {75 mm} [3"] and larger:
 - .1 ASTM A53 Schedule 40 pipe with {1050 kPa} [150 lbs.] malleable iron fittings.
 - .2 Ridged PVC pipe conforming to CAN/CSA B137.3, piping for pressure applications.

2.2. VALVES

- .1 Provide valves to the following numbers:
 - .1 Ball Valves:
 - .1 {65 mm} [2-1/2"] and smaller - soldered {1400 kPa} [200 psi] w.o.g. (Kitz 858)
 - .2 {75 mm} [3"] and larger - flanged {1400 kPa} [200 psi] w.o.g. (American valve #4000).
 - .2 Gate Valve
 - .1 {75 mm} [3"] and larger - flanged {1400 kPa} [200 psi] w.o.g. (Kitz Fig. 75).
 - .3 Standard Check Valves:
 - .1 {65 mm} [2-1/2"] and smaller - soldered {2070 kPa} [300 psi] w.o.g. (Kitz 823T).
- .2 For {50 mm} [2"] and smaller, ball valves may be provided as substitute for gate and globe valves. Provide ball valves with brass or bronze body, chrome plated solid ball, PTFE seats and seals and full port.
 - .1 up to {50 mm} [2"] - {4140 kPa} [600 psig] w.o.g. - soldered Fig 59.
- .3 Provide Check-Rite or Centre Line non-slam check valves on discharge side of pumps and where shown or specified.
- .4 For Victaulic grooved piping systems, provide Victaulic Series 608 lever handle, butterfly valves complete with EPDM-coated disk and drive hub extension insulation block.

PART 3 - EXECUTION

3.1. VERIFICATION OF INVERTS

- .1 Verify all field service conditions immediately after award of Contract to ensure that drainage runs can meet the inverts of the site services.
- .2 Give notification immediately of any apparent difficulties or discrepancies.
- .3 No extra will be paid at a later date for rerouting of drains because site inverts cannot be met.

3.2. TESTING

- .1 Carry out not less than the following tests:

- .1 Ball test drains.
 - .2 Perform water tests on all soil, waste, vent and rainwater systems when rough-in of the system, or section thereof including fittings, branches, cleanouts and traps except fixture traps. When the system or section is filled, shut off the water, and allow to stand for one hour. There shall be no loss by leakage during this time.
 - .3 Pressure test domestic cold water, domestic hot water, and recirculation lines with water at 150% of maximum operating pressure, for 6 hours without loss of pressure.
- .2 Conduct additional tests required by the authorities having jurisdiction.
 - .3 If tests are required by an authority having jurisdiction, perform tests in the presence of each governing authority's authorized inspector, and obtain certification.
 - .4 Certify tests not required by the authorities having jurisdiction.
 - .5 Perform tests before piping, drains or vents are covered or concealed.
 - .6 Remove all components which will not withstand test pressure, and replace after tests.
 - .7 Eliminate leaks, or remove and refit defective parts. Caulking of threaded or welded joints will not be permitted.
 - .8 Repeat tests as often as necessary to obtain certification.
 - .9 Set all fixtures and fill all traps with water after tests have been completed.
- 3.3. CLEANING AND FLUSHING SEWERS
- .1 On completion of construction of drains, flush all drains until the deposits of earth and other foreign material have been removed.
- 3.4. CLEANING, FLUSHING AND DISINFECTING WATER PIPING
- .1 Be responsible for care and cleaning of the piping system during and after construction. Plug all open ends during construction to prevent the entrance of foreign materials.
 - .2 Ensure by operation of isolating valves or the installation of check valves, that the disinfecting solution does not flow back into street mains or other sections of piping in use.

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PART 1 - GENERAL

1.1. WORK INCLUDED

- .1 Comply with Division 1, General Requirements and all documents referred to therein.
- .2 Provide all labour, materials, products, equipment and services to supply and install the bilge, sewage and sump pumps indicated on the Drawings and specified in this Section of the Specifications.

PART 2 - PRODUCTS

2.1. SUBMERSIBLE PUMP

- .1 Pump capacity shall be as shown in the Pump Schedule
- .2 Submersible pump system shall be base bid Sulzer. For consideration of alternatives cost savings must be presented at the time of closing. Contractors proposing alternative manufacturers are responsible for all costs for all trades and all costs for engineering design time as required associated with such a substitution. The dimensions, configurations, performance of equipment from alternative manufacturers must be as shown on the plans.
- .3 The impeller shall be constructed of corrosion resistant chilled gray iron and shall be semi-open, non-clogging, dynamically balanced multi-vane design. The impeller shall have a slip fit onto a shaft and drive key and shall be fastened by a stainless steel bolt.
- .4 The pump volute shall be constructed of gray cast iron with smooth internal surfaces free of rough spots or flashing. The volute shall have a horizontal discharge.
- .5 O-Rings and Fasteners: All mating surfaces of the pump and motor shall be machined and fitted with BUNA-N O-Rings where water sealing is required. Sealing shall be accomplished by the proper fitting of the parts not by compression or special torque requirements. All fasteners shall be 316 stainless steel.
- .6 Shaft and Bearings: The common pump and motor shaft shall be 420 stainless steel supported on the impeller end by a heavy duty single row ball bearing on 1.3 - 2.4 hp pumps, or a heavy duty double row ball bearing on 3.4 - 4 hp pumps. The opposite end of the shaft is supported on a sealed single row ball bearing (all motors).
- .7 Shaft Seals: Each pump shall be equipped with two (2) seals. The lower seal (pump side) shall be of the mechanical type with silicon carbide faces. The upper seal shall be a lip type seal. The seals shall be separated by an oil chamber providing cooling and lubrication of the seals, and a barrier between the pumped fluid, and the dry motor chamber.
- .8 Seal Failure Warning System: A probe shall be provided in the oil chamber to detect the presence of water in the oil. A solid-state device mounted in the pump control panel or in a separate enclosure shall send a low voltage, low amperage signal to the probe. If water enters the oil chamber in sufficient quantity to warrant concern, the probe shall activate a warning light in the control panel.
- .9 The motor shall be air-filled and shall have Class "F" insulation. The rotor and stator shall be enclosed in a cast iron outer housing. Bi-metallic thermal switches shall be imbedded in each phase of the winding to sense high temperature. The rating of the switch shall be 130°C +/- 5°C. The control circuit shall be connected through the bi-metallic switches so the motor is

shut down should a high temperature condition exist. The switches shall be self-resetting when the motor cools. Power cable shall be UL and CSA approved.

- .10 All models shall be UL and CSA approved. All models shall be FM approved for Class I Division I Group C and D.

2.2. PUMP CONTROLLER

- .1 The microprocessor-based pump controller PC242 must be an electronic device to control a pumping station with up to 2 pumps. The start and stop settings of each pump must be freely adjustable from the menu, as the set-point relative to the high and low level alarms.
- .2 The controller will accept a connection from a level sensor, but it must be standardized in order to have it interface able to different types of level/pressure sensors using either standard 0/4-20mA inputs or float switch inputs. This operation will not require any external power supply, because the controller itself will supply the voltage of 24Vdc for the sensor.
- .3 The microprocessor-based pump controller PC242 must be an electronic device to control a pumping station with up to 2 pumps. The start and stop settings of each pump must be freely adjustable from the menu, as the set-point relative to the high and low level alarms.
- .4 The controller will accept a connection from a level sensor, but it must be standardized in order to have it interfaceable to different types of level/pressure sensors using either standard 0/4-20mA inputs or float switch inputs. This operation will not require any external power supply, because the controller itself will supply the voltage of 24Vdc for the sensor.
- .5 The controller must be available for integration into a control panel with NEMA protection. The terminals must be of plug-in type with screw connections, in order to easily terminate the final wiring.
- .6 All the information and parameters must be shown or modified directly via the front-panel graphical display keypad. The alarms and the pump status are shown on the front-panel as a dynamic real time display. The controller must be able to start alternating the external devices connected to the controller; the user is allowed to decide the type of alternation required. The alternation types must include runtime alternation (switches after a programmable number of running hours of the lead pump), asymmetrical alternation (switches after a programmable number of stops of the lead pump) and normal alternation (switches upon successive lead pump stops). This is important to maintain homogeneous starting number and the working hours of each pump. The maximum measurable level must be shown directly in feet. The level has to be measured with a 14 ½ bit resolution (equals to about 20.000 point); The microprocessor technology and high level resolution described previously must be able to calculate the inflow and the outflow of the pump pit along with the effective flow of each pump. The controller must be able to program the set-point about the low flow alarm for each pump. The controller must be able to indicate a low supply voltage, power failure, and microprocessor check sum error.
- .7 The controller must have analog inputs, 14 programmable digital inputs, and 6 digital outputs (potential free contact) described as follows:
 - .1 DIGITAL INPUTS
 - .1 Start Float/Run Confirmation - to confirm the real start of the pumps connected to each output; if the inputs are not utilized to confirm the start, the input must be used to indicate generic alarms and the forced disable of the pumps.

- .2 High Level Float - to activate the high level alarms received from the high level float in order to start eventual emergency sequences
- .3 Overflow Sensor - to indicate the exact overflow instant, in order to activate the overflow alarm input in order to increase the overflow number and duration and to start the eventual overflow flow calculation (and the total volume overflowed).
- .4 Motor protector (P1 and P2) - to indicate an overload condition
- .5 Manual start (P1 and P2) - to indicate that the H-O-A switch has been positioned to the hand mode; the switch will send an input per pump and from the mixer.
- .6 Run Indicator (P1 and P2) - to indicate a running condition on each pump.
- .7 Energy or rain meter (1 and 2) - an input originating from a pulsed channel device to relay precipitation or energy information
- .8 Low Level Float - to activate the low level alarms from the float in order to initiate the associated alarm sequence.
- .9 Man on site - to indicate that panel has been switched to man on site status

.2 DIGITAL OUTPUTS

- .1 Pump Control (P1 and P2) - with internal relay to start and stop the pumps of the electro-mechanical devices controlled by the equipment.
- .2 Common Alarm Output - with internal relay to be used for indicating alarms to the device or in the plant based on settings
- .3 Mixer Control - to be used for start/stop of mixers depending on settings.
- .4 Motor Protector Reset - to be used for resetting of electronic motor protector.
- .5 Alarm indication - programmable output to be used to reset motor protector/modem supply.

.3 DIGITAL OUTPUTS

- .1 Sensor - input from the pressure transducer type sensor. The range is programmable from 0-20mA or 4-20mA to indicate pit level. The readout must be selectable either metric or US units.
- .2 Motor current - input from the motor to monitor current. The range is programmable from 0-20mA or 4-20mA. The readout will be in amperes.
- .3 Pressure - input from a 0-20mA or 4-20mA sensor to indicate line pressure. The readout must be selectable either metric or US units.
- .4 Temperature - input from a PT100 or PTC type RTD sensor. The inputs are from each pump. The readout must be selectable either metric or US units.
- .5 The controller must also include seal sensor inputs for sensing moisture in the pump. The input must be capable of receiving an input from a di-

electrode probe measuring resistivity in the oil chamber of the pump. The input can be programmed to just indicate an alarm or to shut down the pump in case of failure.

- .6 The controller must be able to log in certain values to establish trending. It must be able to interface to a programming tool such as Aquaprog software or Aquaweb to display and print the trend curves. The interface will be via the service port. An optional modem can be used for dial-up or mobile GSM telephone line. In that case dynamic graphical software can be utilized to view in real time the plant status (measured level, pumps running or in failure, calculated flows, alarms, etc.). In both cases, the communication standard for data transmission is the COMLI/modbus protocol.
- .7 The standard supply voltage must be 24VDC or 12VDC by mean external battery. The temperature operative range must be 32° F up to +150° F.

2.3. ULTRASONIC LEVEL MEASURING TRANSDUCERS

- .1 Provide a Siemens model XPS-15 ultrasonic level measuring transducer, capable with the Sulzer PC 242 controller. Housing shall be constructed of PVDF. The transducer shall be complete with a submergence shield

2.4. DUPLEX CONTROL PANEL AND ALARM

- .1 Duplex Indoor NEMA 4 enclosure with main disconnect, IEC rated motor contractors, overload protection, float control logic, pump terminal blocks, float switch terminal blocks, dry contact terminal blocks, ground lugs, pump run lights, high level light and alarm bell, dry contacts for remove alarm, hand-off-auto switches, mechanical alternator, alarm test and acknowledge switches, audible high water alarm buzzer, steel enclosures, pump overload fault lockout, transfer alarm - manual resets, four (4) float circuitry, manual reset alarm and four (4) floats to control the following functions: Stop Pumps; Start Lead Pump; Start Lag Pump; High Water Alarm;
- .2 Control panel shall require only a single power supply by the Electrical Division. All conduit shall enter from the bottom only.
- .3 The switching mechanism connected to one of the floats shall be a mechanical alternator. Action of the alternator shall be to alternate the lead pump in sequential starts. The switching mechanism connected to the other float shall start both pumps should the water level rise above the operating level of the alternator float.
- .4 Provide a high water alarm switch complete with transformer, audible buzzer, and auxiliary contacts for wiring to the building BAS system.
- .5 Control panel shall have following operating logic: When H-O-A switch is put at Auto position, the lead pump shall start at "Start pump" level. Lag pump shall start if the liquid level reaches "Start Lag Pump" level. Both pumps shall stop at "Stop Pump" level. The pumps shall alternate every cycle. If the liquid level rises to "High Water Alarm" level, the buzzer should be activated together with dry contact for BAS monitoring. Each level shall have individual float for automatic pump operation.

PART 3 - EXECUTION

3.1. INSTALLATION

.1 General

- .1 Provide pump outlet piping and sump vent piping with unions or fittings arranged such that the pump can be disconnected for removal and servicing.
- .2 Install in each discharge line, a union connection, non-slam check valve and a gate valve in that sequence in the direction of discharge.
- .3 Set up the level controls for simplex systems to cycle pump.
- .4 Set up the level controls for duplex systems to provide lead/lag operation. Arrange the lag pump start level to be approximately {150 mm} [6 in.] above that of the lead pump. Set the stop level similarly.
- .5 Install pumps with integral level control at different heights in the pit to achieve lead/lag operation.
- .6 Install angle iron pit rim plates during concrete pouring with bolts arranged to accept the pit cover plate.
- .7 In addition to local alarm provide high level alarm through the BMS. Set alarm level switches to activate at approximately {150 mm} [6"] above lag pump start level.

.2 Submersible Sewage and Bilge Pumps

- .1 Submersible bilge and sewage pumps shall not bear directly on the sump floor.
- .2 Install pumps in accordance with manufacturers recommendations and suggested arrangement. Provide guide bars to fit the pump guides. Ensure seal between pump discharge and discharge connection.

3.2. STARTUP AND TESTING

- .1 Manufacturer's service technician for column pumps shall check alignment of bearings, drives and motors after installation to ensure that no misalignment exists, The technician shall make any alignment adjustments prior to startup.
- .2 Manufacturer's service technician shall lubricate bearings at time of startup.
- .3 Setup level controls, verify alarm signals, and record operating pressure and amperage readings. Submit for Consultant review.

END OF SECTION

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1 GENERAL

1.1 APPLICATION

- .1 This Section specifies products, common criteria and characteristics, and methods and execution that are common to one or more electrical work Sections of the Specification, and it is intended as a supplement to each Section and is to be read accordingly.

1.2 SUBMITTALS

- .1 Submit the following for review:
- .1 **product data sheets:** submit for:
 - .1 firestopping and smoke seal products
 - .2 waterproofing seal assemblies
 - .3 electrical work identification products
 - .2 **access door locations:** submit white prints of architectural reflected ceiling plan drawings and elevation drawings to indicate proposed access door locations in walls and ceilings in finished areas
 - .3 **samples:** submit a sample of each proposed type of access door, and samples of materials and any other items as specified in electrical work Sections of the Specification
 - .4 **list of equipment nameplates:** submit a list of equipment identification nameplates indicating proposed wording and sizes
 - .5 **conduit & conductor identification:** submit a list of conduit and conductor identification colour coding and wording
 - .6 **sleeve and formed opening location drawings:** submit, prior to concrete pours, accurately dimensioned drawings to locate all required sleeves, formed openings, and recesses required in poured concrete
 - .7 **waste management and reduction plan:** submit a waste management and reduction plan prior to commencing work and as per requirements specified in this Section
 - .8 **additional submittals:** submit any other submittals specified in this Section or other electrical work Sections of the Specification

2 PRODUCTS

2.1 SLEEVES

- .1 Use for poured concrete construction.
- .2 Use only for waterproof sleeves in new poured concrete construction, i.e. through waterproof slabs or foundation walls.

- .3 **Galvanized Steel:** Schedule 40 mild galvanized steel.

2.2 MULTI-CABLE TRANSITS

- .1 UL/ULC listed and labelled multi-cable transits sized to suit the fire barrier opening and the number of cables/conduits involved and to facilitate a minimum 2 hour water-tight fire and smoke seal. Each assembly is to be complete with a stainless steel frame, cadmium plated compression bolts, proper end packing, compression plates, steel stay plates, and fire rated neoprene insert blocks.

2.3 FIRESTOPPING AND SMOKE SEAL MATERIALS

- .1 Firestopping and smoke seal system materials for electrical penetrations through fire rated construction are specified in Division 07 and the work will be done as part of the work of Division 07.

2.4 WATERPROOFING SEAL MATERIALS

- .1 Modular, mechanical seal assemblies consisting of interlocking synthetic rubber links shaped to continuously fill the annular space between the pipe and the pipe sleeve or wall opening, assembled with stainless steel bolts and pressure plates and designed so that when the bolts are tightened the links expand to seal the opening watertight. The seal assemblies are to be selected to suit the pipe size and the sleeve size or wall opening size. Acceptable products are:

- .1 Thunderline Corp. (Power Plant Supply Co.) "LINK SEAL" Model S-316;
- .2 The Metraflex Co. "MetraSeal" type ES.

2.5 ESCUTCHEON PLATES

- .1 One-piece chrome plated brass or #4 finish type 302 stainless steel plates with matching screws for attachment to the building surface, each plate sized to completely cover the conduit/cable sleeve or building surface opening, and to fit tightly around the conduit or cable.

2.6 ACCESS DOORS

- .1 Prime coat painted steel (unless otherwise specified) flush access doors, each complete with a minimum #16 gauge frame, minimum #18 gauge door panel, heavy-duty rust-resistant concealed hinges, a positive locking screwdriver lock, and mounting and finishing features to suit the particular construction in which it is to be installed.
- .2 Access door sizes are to suit the concealed work for which they are supplied, and wherever possible they are to be of a standard size for all applications, but in any case they are to be minimum 300 mm x 300 mm (12" x 12") for hand entry and 600 mm x 600 mm (24" x 24") for body entry.
- .3 Access doors in fire rated construction are to be ULC listed and labelled and of a rating to maintain the fire separation integrity.
- .4 Where access doors are located in surfaces where special finishes are required, they are to be of a recessed door type capable of accepting the finish in which they are to be installed so as to maintain the final building surface appearance throughout, and constructed of stainless steel with a #4 finish.

2.7 IDENTIFICATION MATERIALS

- .1 **Equipment Nameplates:** Minimum 1.6 mm (1/16") thick 2-ply laminated coloured plastic plates, minimum 12 mm x 50 mm (½" x 2") for smaller items such as single phase starters and switches, minimum 25 mm x 65 mm (1" x 2½") for equipment, and minimum 50 mm x 100 mm (2" x 4") for control panels and similar items. Additional requirements are as follows:
 - .1 unless otherwise specified or required, each nameplate is to be white, complete with bevelled edges and black engraved capital letter wording to completely identify the equipment and its use with no abbreviations;
 - .2 wording is generally to be as per the drawings, i.e. Lighting Panel A, and is to include equipment service and building area/zone served, but must be reviewed prior to engraving;
 - .3 supply stainless steel screws for securing nameplates in place
 - .4 nameplates for equipment suspended above floor level or generally not within easy viewing from floor level are to be increased in size so as to be easily readable from floor level
- .2 **Self-Adhesive Labels:** Equal to Brother "P-Touch" or Thomas & Betts Canada Ltd. "EZCODE" Model EZL500 electronic labelling system self-adhesive labels with size and colour as directed, and permanently printed circuit identification nomenclature which is to be approved by the Consultant prior to producing the labels.
- .3 **Warning Signs:** Equal to Thomas & Betts Canada Ltd. "BP" Series 250 mm x 355 mm (10" x 14") semi-rigid vinyl signs with corner screw holes, the required printed wording (generally red on a white background with black trim), pressure sensitive adhesive on the back, and stainless steel screws.
- .4 **Conduit and Armoured Cable Identification:** Equal to Brady Canada minimum 50 mm (2") wide self-adhesive coloured vinyl tape.
- .5 **Conductor Terminations:** Equal to Electrovert Ltd. Slip-on "Z" type
- .6 **Conductor Colour Coding:** As specified with the conductors.

2.8 ELECTRICAL ENCLOSURES

- .1 Unless otherwise specified electrical enclosure are to be wall mounting NEMA/EEMAC/CSA enclosures as follows:
 - .1 indoor in sprinkler protected areas, Type 2
 - .2 indoor in high humidity/washdown areas, Type 4
 - .3 indoor in corrosive environments, Type 4X, 316 stainless steel
 - .4 indoor explosion-proof, Class 1, Groups C & D, Type 7
 - .5 outdoor, Type 3R
 - .6 indoor in non-hazardous areas except as noted above, Type 1

2.9 ENCLOSURE BACKBOARDS

- .1 Construction grade Fir plywood, G1S, 20 mm ($\frac{3}{4}$ ") thick with width and length to suit enclosure dimensions, coated on all surfaces with a ULC listed water based latex intumescent flame retardant paint, ASTM E-84 Class A rated.

3 EXECUTION

3.1 GENERAL ELECTRICAL WORK INSTALLATION REQUIREMENTS

- .1 Unless otherwise specified, locate and arrange horizontal conduits, raceways, and conductors above or at the ceiling on floors on which they are shown, arranged so that under consideration of all other work in the area, the maximum ceiling height and/or usable space is maintained.
- .2 Unless otherwise specified, install all conduits and conductors concealed in finished spaces, and concealed to the degree possible in partially finished and unfinished spaces. Refer to and examine the Architectural drawings and room finish schedules to determine finished, partially finished, and unfinished areas. Note that walls which are painted are considered finished.
- .3 Unless otherwise specified conduits and main distribution conductors may be exposed in equipment rooms.
- .4 Install all exposed conduits, raceways, and conductors parallel to building lines and to each other.
- .5 Do not install conduit, raceway, or conductors within 150 mm (6") of "hot" piping or equipment.
- .6 All conduit, raceway, conductors, etc., must be supported from the structure, not from ceiling hangers, piping, ductwork, cable tray, and similar mechanical or electrical products.
- .7 Neatly group and arrange all exposed work. Do not install conduit to prevent access into equipment.
- .8 **Access:** Locate all work to permit easy access for service or maintenance as required and/or applicable. Locate all products which will or may need maintenance or repairs and which are installed in accessible construction so as to be easily accessible from access doors. Where such products occur in vertical services in shafts, pipe spaces or partitions, locate the accessories at the floor level.
- .9 **Manufacturer's Instructions:** Ensure that equipment and material manufacturer's installation instructions are followed unless otherwise specified herein or on the drawings, and unless such instructions contradict governing codes and regulations.
- .10 **Cleaning:** Carefully clean all conduits, raceway, fittings prior to installation. Temporarily cap or plug ends of conduit which are open and exposed during construction.
- .11 **Surfaces To Receive Your Work:** Inspect surfaces and structure prepared by other trades before performing your work. Verify that surfaces or the structure to

receive your work have no defects or discrepancies which could result in poor application or cause latent defects in installation and workmanship. Report defects in writing. Installation of your work will constitute acceptance of such surfaces as being satisfactory.

- .12 **Repair of Finished Surfaces:** For factory applied finishes, repaint or refinish all surfaces damaged during shipment and installation. The quality of the repair work is to match the original finish. This requirement also applies to galvanized finishes.

3.2 INSTALLATION OF SLEEVES

- .1 Where conduits, round ducts, and armoured cable pass through concrete and/or masonry surfaces provide sleeves as follows:
 - .1 **in poured concrete slabs:** unless otherwise specified - minimum 16 gauge flanged galvanized steel or, where permitted by governing authorities, factory fabricated plastic sleeves
 - .2 **in concrete or masonry walls:** Schedule 40 galvanized steel pipe
- .2 **Waterproof Sleeves:** Provide waterproof sleeves in the following locations:
 - .1 in mechanical room floor slabs, except where on grade
 - .2 in slabs over mechanical, fan, electrical and telephone equipment rooms or closets
 - .3 in all floors equipped with waterproof membranes
 - .4 in the roof slab
 - .5 in waterproof walls
- .3 Size sleeves, unless otherwise specified, to leave 12 mm ($\frac{1}{2}$ ") clearance around the conduit, duct, cable, etc.
- .4 Pack and seal the void between the sleeves and the conduit, duct, cable, etc., in non-fire rated construction for the length of the sleeves as follows:
 - .1 **interior construction:** pack sleeves in interior construction with mineral wool and seal both ends of the sleeves with non-hardening silicone base caulking compound
 - .2 **exterior walls above grade:** pack sleeves in exterior walls above grade with mineral wool and seal both ends of the sleeves water-tight with approved non-hardening silicone base caulking compound unless mechanical type seals have been specified
 - .3 **exterior walls below grade:** seal sleeves in exterior walls below grade (and any other wall where water leakage may be a problem) with link type mechanical seals as specified below.
- .5 Where sleeves are required in masonry work, accurately locate and mark the sleeve location, and hand the sleeves to the mason for installation.
- .6 Terminate sleeves that will be exposed so that the sleeve is flush at both ends with the building surface concerned so that the sleeve may be completely covered by an

escutcheon plate, except for sleeves in waterproof floors which are to terminate 100 mm (4") above the finished floor.

- .7 "Gang" type sleeving will not be permitted.
- .8 Where sleeves are provided in non-fire rated construction for future services, or where conduit, ducts, cable, etc., has been removed from existing sleeves, cap and seal both ends of the sleeved opening.

3.3 RECTANGULAR OPENINGS

- .1 Rectangular openings for cable tray, raceways, multiple conduits and/or cables and similar rectangular openings will be provided in new poured concrete work, masonry, drywall and other building surfaces by the trade responsible for the particular construction in which the opening is required.
- .2 **Waterproof Openings:** Provide watertight link type mechanical seals in exterior wall openings where shown or specified. Assemble and install each mechanical seal in accordance with the manufacturer's instructions. After installation, periodically check each mechanical seal installation for leakage and, if necessary, tighten link seal bolts until the seal is completely watertight.
- .3 **Openings In Non-Fire Rated Construction:** For all rectangular openings in non-fire rated construction pack and seal the space between the conduits, ducts, cables, etc., with mineral wool for the full thickness of the building surface penetrated, and seal both ends.
- .4 **Openings In Fire Rated Construction:** Provide multi-cable transits in all fire rated openings and install in accordance with the manufacturer's instructions.

3.4 SLEEVE AND FORMED OPENING LOCATION DRAWINGS

- .1 Prepare and submit for review, white print drawings indicating the size and location of all required sleeves, recesses and formed openings in poured or precast concrete work.
- .2 Such drawings are to be completely and accurately dimensioned and relate sleeve, recesses, and formed openings to suitable grid lines and elevation datum, and are to take into account structural items such as grade beams, column caps, and column drop slabs
- .3 Begin to prepare such drawings immediately upon notification of acceptance of bid and award of Contract.

3.5 INSTALLATION OF ESCUTCHEON PLATES

- .1 Provide escutcheon plates suitable secured over all exposed conduits, ducts, armoured cable, etc., passing through finished building surfaces. A finished building surface is any surface with a factory finish or that receives a site applied finish.
- .2 Install the plates so that they are tight against the building surface concerned, and ensure that the plates completely cover sleeves and/or openings, except where waterproof sleeves extend above floors, in which case the plate is to fit tightly around the sleeve.

3.6 INSTALLATION OF FASTENING AND SECURING HARDWARE

- .1 Provide fastening and securing hardware required for electrical work to maintain installations attached to the structure or to finished floors, pads, walls, and ceilings in a secure and rigid manner capable of withstanding the dead loads, live loads, superimposed dead loads, and any vibration of the installed products.
- .2 Use fasteners compatible with structural requirements, finishes and types of products to be connected. Do not use materials subject to electrolytic action or corrosion where conditions are liable to cause such action.
- .3 Where floor, wall, or ceiling construction is not suitable to support the loads, provide additional framing or special fasteners to ensure proper securement to the structure. Provide reinforcing or connecting supports where required to distribute loading to structural components.
- .4 Obtain written consent before using explosive actuated fastening devices. If consent is given comply with requirements of CAN3-Z166.1 and .2.
- .5 Do not attach fasteners to steel deck without written consent from the Consultant.

3.7 SUPPLY OF ACCESS DOORS

- .1 Supply access doors to give access to all electrical work which may need maintenance or repair but which is concealed in inaccessible construction, except as otherwise specified herein or on the drawings.
- .2 Locate access doors as inconspicuously as possible in walls and partitions and arrange electrical work such that it is clearly within view and accessible for inspection and servicing, and to suit access door locations shown on the reviewed and approved white prints of reflected ceiling plan and elevation drawings submitted as per Part 1 of this Section.
- .3 Group services to ensure the minimum number of access doors is required. Access doors will be installed by the trades responsible for the particular type of construction in which the doors are required.
- .4 Submit a sample of each proposed access door for review prior to ordering.

3.8 ELECTRICAL WORK IDENTIFICATION

- .1 Identify all new/relocated electrical work in accordance with existing identification standards at the site.
- .2 Identify all electrical work, including conduit systems and wiring, as follows:
 - .1 the size and wording of identification nameplates must be approved by the Consultant
 - .2 identification wording for equipment is to follow drawing nomenclature unless otherwise specified
 - .3 secure nameplates to equipment with stainless steel screws unless such a practice is prohibitive, in which case use epoxy cement applied to cleaned surfaces

- .4 locate nameplates in the most conspicuous and readable location
 - .5 for multi-cell or multiple component equipment provide a main nameplate and a smaller nameplate for each cell or component
 - .6 where electrical work is to be identified in conjunction with mechanical work, coordinate with the mechanical trades to ensure identical tagging
 - .7 all identification wording is to be in English
 - .8 all identification and colour coding is to be indicated on "as-built" record drawings
- .2 **Terminal Cabinets, Pull Boxes, Junction Boxes, Etc.:** Clearly identify terminal cabinets, main pull and junction boxes by neatly spray painting the outside surface of the cover with a paint colour as specified below for conduit and conductor identification.
Provide a nameplate on terminal boxes, main pull and junction boxes in communication systems specified in Division 27.
- .3 **Transformers:** Transformer nameplated must identify the transformer capacity as well as primary and secondary voltages.
- .4 **Branch Circuit Panelboards:** Panelboard nameplates must identify the electrical source connected to the panelboard, each circuit breaker, and, neatly typed on the door directory card, the load connected to each breaker.
- .5 **Luminaires On Emergency Circuits:** Identify all luminaires on emergency circuit by means of a 15 mm ($\frac{1}{2}$ ") diameter self-adhesive red label secured to the T-bar ceiling component adjacent to the luminaire, or if not in a T-bar ceiling, to the frame of the luminaire.
- .6 **Lighting Switches & Receptacles:** Identify each lighting switch and each receptacle by means of a permanent self-adhesive label indicating the source panelboard and circuit number and secured to the device faceplate.
- .7 **Communication Equipment/Systems:** Identify all "head end" equipment with nameplates and all "downstream" devices with self-adhesive labels indicating circuit numbers.
- .8 **Warning Signs:** Provide appropriately worded warning signs secured in place with stainless steel hardware in locations as follows:
- .1 on all doors into transformer vaults
 - .2 on all doors into high voltage switchgear rooms
 - .3 on all collector bus enclosures
 - .4 on pad mounted transformer enclosures
 - .5 wherever else required by Code
- .9 **Conduit & Armoured Cable:** Colour code conduit and armoured cable by means of 25 mm (1") wide primary colour plastic adhesive backed tape or neatly applied suitable paint with, where scheduled, a 20 mm ($\frac{3}{4}$ ") wide auxiliary colour at all points

where the conduit or cable penetrates a wall, ceiling, floor, at 6 m (20') intervals or at least once in each room or accessible ceiling space, at each access door location, and elsewhere at 15 m (45') intervals. Unless otherwise indicated/specified, colours are to be as follows:

Service	Primary Colour	Secondary Colour
up to 250 volts	yellow	
250 to & including 600 volts	yellow	green
above 600 volts to 5 kV	yellow	blue
above 5 kV to 28 kV	yellow	red
telephone	green	
fire alarm	red	
emergency voice	red	blue
security systems	red	yellow
other communication systems	green	
isolated power	orange	

- .10 **Wire & Cable Terminations:** Identify both end of wire and cable terminations with the same unique number. Where numbers are not indicated or specified, assign a number and record them.
- .11 **Buried Cable/Duct Runs:** Identify buried cable/duct runs under paved and landscaped areas with appropriate concrete markers, flush with grade at each change in direction, at least twice on runs less than 60 m (200') and on 60 m (200') centres on longer runs.
- .12 **Overhead Wiring Service Poles:** Unless otherwise indicated on the drawings identify poles with wording such as "HV#1". For wooden poles use 50 mm (2") high non-corrosive embossed aluminium pole markers. For concrete poles use non-corrosive metal plated secured to the pole with metal strapping.
- .13 **Health Care Patient Care Area Circuits:** For dedicated circuits provide identification as previously specified plus engraved "Dedicated Circuit" nameplates on the device faceplate, or provide faceplates with "Dedicated Circuit" engraved wording. For 20 ampere corridor housekeeping receptacles provide "20A Housekeeping" nameplates on the device faceplate.
- .14 **Distribution System Schematic Diagrams:** Prepare AutoCAD, coloured, 1200 mm x 900 mm (48" x 36") schematic diagrams of electrical distribution systems to identify all equipment and circuits. Install framed and glazed diagrams in electrical rooms housing the system equipment. Confirm location prior to installation. Include reduced size copies of the diagrams in each copy of the O & M Manuals.

3.9 INSTALLATION OF TERMINAL BACKBOARDS

- .1 Provide properly sized plywood backboards for wiring terminals in terminal cabinets and enclosures where shown/specified/required.

3.10 GENERAL ELECTRICAL WORK TESTING

- .1 Perform testing in accordance with the Electrical Work Testing Section, and, in addition, any tests required by governing Codes, Standards.

3.11 BRANCH CIRCUIT BALANCING

- .1 Connect all branch circuits to panelboards so as to balance the actual loads (wattage) to within 5%. If required, transpose branch circuits to achieve this requirement.
- .2 After the building is occupied and if requested by the Consultant, demonstrate that branch circuit balancing has been achieved.

3.12 SUPPLY OF MOTOR STARTERS AND ACCESSORIES

- .1 Motor starters for mechanical equipment will be supplied as part of the mechanical work.

3.13 ELECTRICAL WIRING WORK FOR MECHANICAL WORK

- .1 Unless otherwise specified or indicated, the following electrical wiring work for mechanical equipment is to be done as part of the electrical work:
 - .1 "line" side power wiring to motor starters or disconnect switches in motor control centres and starters or disconnects on motor starter panels, and "load" side wiring from the starters or disconnects to the equipment
 - .2 mounting of individual starters, "line" side power wiring to individual wall mounted starters, and "load" side wiring from the starters to the equipment
 - .3 "line" side power wiring to pre-wired power and control panels and variable frequency drives, and "load" side power wiring from the panels and VFD's to the equipment
 - .4 provision of receptacles for plug-in equipment
 - .5 provision of disconnect switches for all motors that are in excess of 10 m (30') from the starter location, or that cannot be seen from the starter location, and all associated power wiring
 - .6 all motor starter interlocking in excess of 24 volts
 - .7 wiring from motor winding thermistors in motors 30 HP and larger to motor starter contacts
 - .8 provision of dedicated 120 volt, 15A-1P circuits terminated in junction boxes in mechanical equipment rooms for automatic control and building automation system wiring connections to be made as part of the automatic controls work
 - .9 120 volt power connections to electrical receptacles integral with small ceiling exhaust fans, including wiring through light switches or speed controllers;
 - .10 120 volt wiring connections to lighting fixture/switch combinations integral with air handling units
 - .11 120 volt wiring connections to duplex receptacles integral with air handling unit control panels
- .2 Mechanical wiring work not listed above or specified herein or on the drawings will

be done as part of the mechanical work in accordance with wiring requirements specified for the electrical work.

3.14 INTERRUPTION TO AND SHUT-DOWN OF ELECTRICAL SERVICES AND SYSTEMS

- .1 Co-ordinate all shut-down and interruption to existing electrical systems with the Owner.

Generally, shut-downs may be performed only between the hours of 12:00 midnight Friday until 6:00 a.m. Monday morning.

- .2 Upon award of a Contract, submit a list of anticipated shut-down times and their maximum duration.
- .3 Prior to each shut-down or interruption, inform the Owner and Consultant in writing seventy-two hours in advance of the proposed shut-down or interruption and obtain written approval to proceed. Do not shut-down or interrupt any system or service without such written approval.
- .4 Perform work associated with shut-downs and interruptions as continuous operations to minimize the shut-down time and to reinstate the systems as soon as possible, and, prior to any shut-down, ensure that all materials and labour required to complete the work for which the shut-down is required are available at the site.

3.15 EQUIPMENT BASES AND SUPPORTS

- .1 **Concrete Housekeeping Pads:** Unless otherwise specified or required, set all floor mounted equipment on minimum 100 mm (4") high reinforced concrete housekeeping pads 200 mm (8") clear of the equipment on each side and end, or a minimum of 200 mm (8") from the centreline of equipment anchor bolts to the edge of the base, whichever is larger. Conform to the following requirements:
 - .1 supply dimensioned drawings and equipment base templates, and provide anchor bolts for proper setting and securing of equipment on pads
 - .2 place anchor bolts during the concrete pour and be responsible for all required levelling, alignment, and grouting of the equipment
 - .3 as a minimum, use wire mesh reinforcement, however, for pads for large heavy equipment, use reinforcement as per structural drawing details
- .2 **Structural Steel Stands/Supports:** For equipment not designed for base mounting, where required, provide welded, cleaned and prime coat painted structural steel stands or supports conforming to the following requirements:
 - .1 all stands and supports, except those for small equipment, are to be designed by a structural engineer registered in the jurisdiction of the work, and stamped and signed design drawings with calculations are to be submitted as shop drawings for review
 - .2 all steel stands are to be flange bolted to concrete housekeeping pads
 - .3 all stands and supports are to be seismically restrained in accordance with applicable requirements.

3.16 CONCRETE WORK FOR EQUIPMENT BASES/PADS

- .1 All concrete work required for electrical equipment bases/pads will be provided as part of the concrete work of Division 03.
- .2 Exactly locate bases/pads at the site and be present during the concrete pour to ensure that anchor bolts, inserts, plates and similar hardware are not damaged or dislodged.
- .3 Coordinate base/pad installations with the concrete trade and ensure that bases and pads are keyed into the structure to meet seismic restraint requirements.

3.17 CONCRETE WORK FOR EQUIPMENT BASES/PADS

- .1 Provide all poured concrete work, including reinforcing and formwork, required for electrical equipment bases/pads. Perform concrete work in accordance with requirements specified in Division 03.
- .2 Ensure that bases and pads are keyed into the structure to meet seismic restraint requirements.

3.18 EXCAVATION AND BACKFILL WORK

- .1 Excavation, backfill and related work such as dewatering required for electrical work will be performed as part of the excavation and backfill work, except for final hand grading work which is to be done as part of the electrical work.
- .2 Accurately mark-out the location and routing of excavation required for your work, as well as the required depth.

3.19 EXCAVATION AND BACKFILL WORK

- .1 Do all excavation, backfill and related work required for your work. Perform such work in accordance with requirements of the Excavation and Backfill Section, except as modified by this Article. Obtain a copy of the soil test report and review during the bidding period.
- .2 Grade the bottom of trench excavations as required.
- .3 In firm, undisturbed soil, lay ducts, conduits, etc., directly on the soil, unless otherwise directed.
- .4 Unless otherwise specified, backfill trenches within the building with clean sharp sand in individual layers of maximum 150 mm (6") thickness compacted to a density of 100% Standard Proctor. Hand compact the first layers up to a compacted level of minimum 300 mm (12") above the top of the service. Hand or machine compact the balance up to grade.
- .5 Unless otherwise specified, backfill trenches outside the building (not under roads, parking lots or traffic areas), up to a compacted level of 450 mm (18") thick above the service, hand compacted to a density of 95% Standard Proctor, using granular "A" gravel. Backfill the balance in 150 mm (6") layers with approved excavated material, compacted to 95% Standard Proctor density.
- .6 Unless otherwise specified, backfill trenches outside the building under roads,

parking lots or traffic areas with crushed stone or granular "A" gravel in layers not exceeding 150 mm (6") thickness, compacted to 100% Standard Proctor density up to grade level.

- .7 The location and inverts of existing underground site services shown on the drawings are based on available information and are assumed to be correct, however, prior to excavation, carefully check inverts and locations and report any serious discrepancy, and contact Utilities to accurately locate their services.
- .8 You will be held responsible for any damage done to existing underground services caused by neglect to determine and mark out the location of such services prior to excavation work commencing.
- .9 After the first lift of backfill has been compacted, mark the entire path of pipe using continuous 75 mm (3") wide detectable identified marking tape equal to SMS Ltd. D- UGMT.
- .10 Engage the services of an independent soils testing agency to test the final backfill compaction density of each backfilled location. Compact the backfill to the satisfaction of the testing agency and in accordance with the Specification. Submit a copy of the testing agency's report to the Consultant for review.

3.20 CUTTING, DRILLING, AND PATCHING

- .1 Do all cutting, drilling and patching of the existing building for the installation of your work.
Perform all cutting and drilling with proper tools and equipment. Confirm the exact location of cutting and drilling with the Consultant prior to commencing the cutting and/or drilling work.
- .2 Patch surfaces, where required, to exactly match existing finishes using tradesmen skilled in the particular trade or application worked on.
- .3 Where new conduits, conductors, etc., pass through existing construction, core drill an opening. Size openings to leave 12 mm ($\frac{1}{2}$ ") clearance around the product involved.
- .4 Prior to drilling or cutting an opening in poured concrete construction, determine the location, if any, of existing services concealed in the construction to be drilled or cut. X- ray or Ferro Scan Test the walls or slabs if required.
- .5 You will be responsible for the repair of any damage to existing services, exposed or concealed, caused as a result of your cutting or drilling work.
- .6 Where drilling is required in waterproof slabs, size the opening to permit snug and tight installation of a sleeve which is sized to leave 12 mm ($\frac{1}{2}$ ") clearance around the product involved. Provide a sleeve in the opening. Sleeves are to be Schedule 40 galvanized steel pipe with a flange at one end and a length to extend 100 mm (4") above the slab. Secure the flange to the underside of the slab and caulk the void between the sleeve and slab opening with proper non-hardening silicone base caulking compound to produce a water- tight installation.

3.21 PACKING AND SEALING CORE DRILLED OPENINGS

- .1 Pack and seal the void between the core drilled opening and the service insulation for the length of the opening as follows:

- .1 **non-fire rated interior construction:** pack openings in non-fire rated interior construction with mineral wool and seal both ends of the opening with non-hardening silicone base caulking compound to produce a water-tight seal;
- .2 **exterior walls above grade:** pack sleeves in exterior walls above grade with mineral wool and seal both ends of the sleeves water-tight with approved non-hardening silicone base caulking compound unless mechanical type seals have been specified;
- .3 **exterior walls below grade:** seal sleeves in exterior walls below grade (and any other wall where water leakage may be a problem) with link type mechanical seals as specified below.

3.22 CLEANING ELECTRICAL WORK

- .1 Refer to cleaning requirements specified in Division 01.
- .2 Clean **all** electrical work prior to application for Substantial Performance of the work.

3.23 MAINTAINING EQUIPMENT PRIOR TO ACCEPTANCE

- .1 Maintain all equipment in accordance with the manufacturer's printed instructions prior to start-up, testing and commissioning.

3.24 SEISMIC RESTRAINT ANCHOR POINTS FOR EQUIPMENT

- .1 All electrical equipment requiring seismic restraint (see the electrical work Section entitled Seismic Control and Restraint) is to be complete with manufacturer designed and rated seismic restraint anchor points and attachments, certified by the equipment manufacturers, so that the equipment may be bolted down or restrained in the field.
- .2 The equipment to be restrained must be designed such that the strength and anchorage of the internal components of the equipment exceeds the force level used to restrain and anchor the equipment itself to the supporting structure.

3.25 REQUIREMENTS FOR BARRIER-FREE ACCESS

- .1 Include for all applicable requirements for barrier-free access to electrical devices in accordance with governing Codes and Regulations, whether shown on the drawings, specified, or not.

END OF SECTION

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PART 1. – GENERAL

1.1 REFERENCES

The General Conditions of the Contract, the Supplementary Conditions, and all Sections of Division 01 apply to and are a part of this Section of the Specification.

1.2 APPLICATION

This Section specifies requirements that are common to electrical work Sections of the Specification and it is a supplement to each Section and is to be read accordingly.

1.3 NOTE RE: BOLD LETTERING

"Bold" type lettering is used throughout this Specification in an attempt to enhance the readability of the text. The use of "bold" lettering does not indicate a greater level of importance.

1.4 SUBMITTALS

.1 As specified in this Section, submit the following to the Consultant:

- .1 **project close-out documentation:** O & M Manuals, record as-built drawings, and all associated data
- .2 **progress payment breakdown:** a detailed breakdown of the electrical work cost
- .3 **Extended Warranties:** copies of all extended warranties specified, and in the name of the Owner
- .4 **O & M Training Schedules & Manual:** a proposed schedule of demonstration and training dates and times, and a preliminary copy of the training manual developed for operational and maintenance training

1.5 DEFINITIONS

.1 The following are definitions of words found in electrical work Sections of the Specification and on associated drawings:

- i. "concealed" – means work hidden from normal sight in furred spaces, shafts, tunnels, ceiling spaces, walls and partitions
- ii. "exposed" – means work normally visible, including work in electrical and equipment rooms and similar spaces
- iii. "provide" (and tenses of provide) – means supply and install complete
- iv. "install" (and tenses of install) – means install and connect complete
- v. "supply" – means supply only
- vi. "finished area" - means any area or part of an area which receives a finish such as paint, or is factory finished

- vii. "governing authority" and/or "regulatory authority" and/or "Municipal authority" – means all government departments, agencies, standards, rules and regulations that apply to and govern the electrical work and to which the work must adhere
- viii. "Consultant" – means the Architect or Consulting Engineer who has prepared the Contract Documents on behalf of the Owner
- .2 Wherever the words "indicated", "shown", "noted", "listed", or similar words or phrases are used in the specification they are understood, unless otherwise defined, to mean that the product referred to is "indicated", "shown", "listed", or "noted" on the drawings.
- .3 Wherever the words "approved", "satisfactory", "as directed", "submit", "permitted", "inspected" or similar words or phrases are used in the specification or on the drawings they are understood, unless otherwise defined, to mean that work or product referred to is "approved by", "inspected by", etc., the Consultant.
- .4 In the electrical specification, singular may be read as plural, and vice-versa.

1.6 QUALITY ASSURANCE

- .1 All electrical work is to be done by journeyman tradesmen who perform only the work that their certificates permit, or by apprentice tradesmen under direct on site supervision of an experienced journeyman tradesman. The use of apprentice tradesmen is to be limited and the journeyman/apprentice ratio is subject to the Consultant's approval.
- .2 An experienced and qualified superintendent is to be on-site at all times when electrical work is being performed.

1.7 CODES, REGULATIONS, AND STANDARDS

- .1 All Codes, Regulations, and Standards referred to in this Section and in Sections to which this Section applies are the latest edition of the Codes, Regulations, and Standards in effect at the time of bidding on this Project.
- .2 All electrical items are to be certified and bear the stamp or seal of a recognized testing agency such as CSA, UL, ULC, ETL, etc., or bear a stamp to indicate special electrical utility approval.
- .3 Requirements of the Contract Documents are to take precedence when they are more stringent than codes, ordinances, standards, and statutes.

1.8 IMPERIAL AND METRIC MEASUREMENTS

- .1 Conform to requirements of CAN/CSA-Z234.1, Canadian Metric Practice Guide.
- .2 Both Metric and Imperial units of measurement are indicated in the electrical Specification.
Metric measurements are "soft" and have been rounded off.

1.9 EXAMINATION OF SITE AND DOCUMENTS

- .1 When estimating the cost of the work and prior to submitting a bid for the work carefully examine all of the bid documents and visit the site to determine and review

all existing site conditions that will or may affect the work, and include for all such conditions in the bid price.

- .2 Report to the Consultant, prior to bid submittal, any existing site condition that will or may affect performance of the work as per the drawings and specifications. Failure to do so will not be grounds for additional costs.

1.10 DRAWINGS AND SPECIFICATION

- .1 Read the electrical work drawings in conjunction with all other structural, architectural, sprinkler, mechanical, etc., drawings.
- .2 The electrical drawings are performance drawings, diagrammatic, and show approximate locations of equipment and connecting services. Any information regarding accurate measurement of the building are to be taken at the site. Do not scale the drawings, and do not use the drawings for prefabrication work.
- .3 The drawings are intended to convey the scope of work and do not show architectural and structural details. Provide, at your cost, all offsets, fittings, transformations, and similar products required as a result of obstructions and other architectural and structural details but not shown on the drawings.
- .4 The locations of equipment and materials shown may be altered, when reviewed by the Consultant, to meet requirements of the equipment and/or materials, other equipment or systems being installed, and of the building, all at your cost.
- .5 Sections of the electrical specification are not intended to delegate functions nor to delegate work and supply of materials to any specific trade, but rather to generally designate a basic unit of work, and the Sections are to be read as a whole.
- .6 The electrical specification does not generally indicate the specific number of items or extent of material required. The specification is intended to provide product data and installation requirements. It is necessary to refer to drawing schedules, layouts, schematic diagrams, riser diagrams, and details to determine correct quantities.
- .7 The electrical drawings and specification are intended to be cooperative. Perform all work that is shown, specified, or reasonably implied on the drawings but not mentioned in the specification, or vice-versa, as though fully covered by both.
- .8 When the scale and date of the drawings are the same, or when the discrepancy exists within the specification, the most costly arrangement will take precedence.
- .9 In the case of discrepancies between the drawings and specifications, the documents will govern in the order specified in the General Conditions, however, when the scale and date of the drawings are the same, or where the discrepancy exists within the specification, the costliest arrangement will take precedence.

1.11 PLANNING AND LAYOUT OF THE WORK, AND ASSOCIATED DRAWINGS

- .1 Properly plan, coordinate, and establish the locations and routing of services with all subcontractors affected prior to installation such that the services will clear each other as well as any obstructions, including structural components of the building. Unless otherwise specified, the order of right-of-way for services is to be as follows:

- .1 piping requiring uniform pitch
 - .2 piping 100 mm (4") dia. and larger
 - .3 large ducts (main runs)
 - .4 electrical cable tray and bus duct
 - .5 conduit 100 mm (4") dia. and larger
 - .6 piping less than 100 mm (4") diameter
 - .7 smaller branch ductwork
 - .8 conduit less than 100 mm (4") diameter
- .2 Unless otherwise shown or specified, conceal all work in finished areas, and conceal work in partially finished or unfinished areas to the extent made possible by the area construction. Install conduit, raceway, and similar services as high as possible to conserve headroom and/or ceiling space. Notify the Consultant where headroom or ceiling space appears to be inadequate prior to installation of the work.
 - .3 Revise or alter the arrangement of work that has been installed without proper coordination, study and review, even if it was completed in accordance with the Contract Documents, in order to conceal the work behind finishes, or to allow the installation of other work, at no additional cost. In addition, pay for the cost of alterations in other work required by the alterations to your work.
 - .4 All junction boxes, equipment and similar products, particularly such products located above suspended ceilings must be located for easy access for servicing and/or removal. Products which do not meet this location requirement are to be relocated to an accessible location at no additional cost.

1.12 COORDINATION OF THE WORK

- .1 Review all the Contract Documents and coordinate the work with the work of all subcontractors. Coordination requirements are to include, but not be limited to, the following:
 - .1 written notifications of all concrete work such as housekeeping pads, bases, etc., required for electrical work, and including required dimensions, operating weight of equipment, location, etc.
 - .2 depth and routing of excavation required for electrical work, and requirements for bedding and backfill.

1.13 GENERAL RE: INSTALLATION OF EQUIPMENT

- .1 Unless otherwise specified all equipment is to be installed in accordance with the equipment manufacturer's recommendations and instructions, and requirements of governing Codes, Standards, and Regulations. Governing Codes, Standards, and Regulations take precedence over manufacturer's instructions.
- .2 Ensure that proper access and service clearances are maintained around equipment, and, where applicable, access space for future equipment removal or replacement is

not impeded. Remove and replace any equipment which does not meet this requirement.

1.14 PERMITS, FEES, AND CERTIFICATES

- .1 Apply for, obtain and pay for all permits required to complete the electrical work.
- .2 Submit to the Consultant, all approval/inspection certificates issued by governing authorities to confirm that the work as installed is in accordance with the rules and regulations of the governing authorities. Pay any costs associated with issue of the certificates.
- .3 Include a copy of all approval/inspection certificates in each operating and maintenance manual.

1.15 WORKPLACE SAFETY

- .1 Comply with requirements of the Workplace Hazardous Materials Information System (WHMIS) regarding the use, handling, storage and disposal of hazardous materials. Submit WHMIS MSDS (Material Safety Data Sheets) for all products where required, and maintain one copy at the site in a visible and accessible location available to all personnel.
- .2 Comply with all requirements of Occupational Health and Safety Regulations and all other regulations pertaining to health and safety, including worker's compensation/ insurance board and fall protection regulations.

1.16 SHOP DRAWINGS AND PRODUCT DATA SHEETS

- .1 Prior to supplying any products to the site, submit for review, shop drawings and/or product data sheets indicating in detail the design, construction, and performance of products as requested in Sections of this Specification. The number of copies of shop drawings and/or product data sheets will be as later directed.
- .2 Shop drawings are those prepared specifically for the Project. Product data sheets are copies of manufacturer's standard catalogue, etc., literature.
- .3 Unless otherwise specified or required, submit shop drawings/product data sheets via email in AutoCAD or PDF format only.
- .4 Wherever possible, shop drawings and/or product data sheets are to be 215 mm x 280 mm (8½" x 11"), 215 mm x 356 mm (8½" x 14"), or 356 mm x 432 mm (11" x 17") single side white bond paper with sufficient clear space for review stamps, comments, and identification as specified below.
- .5 Shop drawings and product data sheets must confirm that the product proposed meets all requirements of the Contract Documents.
- .6 Each shop drawing or product data sheet is to be properly identified with the project name and the product drawing or specification reference, i.e. "Lighting Fixture F1", and all shop drawing or product data sheet dimensions are to be either SI or Imperial to match dimensions on the drawings.
- .7 Carefully review each shop drawing and product data sheet prior to submittal to ensure that the proposed product is correct and meets with all requirements of the

Project.

- .8 Endorse each copy of each shop drawing or product data sheet "Correct for Review By Consultant", or "Certified to Be In Accordance With All Requirements" and include your company name, the submittal date, and the signature of an officer of your company to indicate your review and approval as above.
- .9 The Consultant will review shop drawings and product data sheets and will indicate the review status by stamping the shop drawings and product data sheets as follows:
 - .1 **"Reviewed" or "Reviewed As Modified"** to indicate that his review is final and no re- submittal is required
 - .2 **"Revise and Resubmit"** to indicate that the submission is rejected and is to be revised in accordance with comments marked on the shop drawings and product data sheets by the Consultant and re-submitted
- .10 The Consultant will retain one or two copies of each shop drawing or product data sheet submission.
- .11 The following is to be read in conjunction with the wording on the Consultant's review stamp applied to each and every electrical work shop drawing or product data sheet submitted:

"This review is for the sole purpose of ascertaining conformance with the general design concept. This review does not approve the detail design inherent in the product data/shop drawings, responsibility for which remains with the Contractor, and such review does not relieve the Contractor of the responsibility for errors or omissions in the product data/shop drawings or of his responsibility for meeting all requirements of the Contract Documents. Be responsible for dimensions to be confirmed and correlated at the job site, for information that pertains solely to fabrication processes or to techniques of construction and installation, and for coordination of the work of all sub-trades."

1.17 CHANGES OR REVISIONS TO THE WORK

- .1 Whenever the Consultant proposes in writing to make a change or revision to the design, arrangement, quantity or type of any work from that required by the Contract Documents, prepare and submit to the Consultant for approval, a quotation being your proposed cost for executing the change or revision.
- .2 Your quotation is to be a detailed and itemized estimate of all products, material, labour, and equipment costs associated with the change or revision, plus overhead and profit percentages and all applicable taxes and duties.
- .3 Unless otherwise stated in the Contract Documents, the following requirements apply to all quotations submitted:
 - .1 when the change or revision involves deleted work as well as additional work, the cost of the deleted work (less overhead and profit percentages but including taxes and duties) is to be subtracted from the cost of the additional work before overhead and profit percentages are applied to the additional work
 - .2 material costs are not to exceed those published in local estimating price guides such as Allpriser, less applicable trade discounts

- .3 costs for journeyman and apprentice labour must not exceed prevailing rates at the time of execution of the Contract and must reflect the actual personnel performing the work
 - .4 cost for the site superintendent must not exceed 10% of the total hours of labour estimated for the change or revision, and the change or revision must be such that the site superintendent's involvement is necessary
 - .5 costs for rental tools and/or equipment are not to exceed local rental costs
 - .6 if overhead and profit percentages are not specified in the General Conditions of the Contract, Supplementary Conditions, or elsewhere in preceding Sections of the Specification, but allowable under the Contract, then allowable percentages for mark- up and overhead and profit are to be 10% and 5% respectively
 - .7 the overhead percentage will be deemed to cover all quotation costs other than actual site labour, product and materials, and rentals
 - .8 all quotations, including those for deleted work, must include a figure for any required change to the Contract time
- .4 Quotations submitted that are not in accordance with requirements specified above will be rejected and returned for re-submittal. Failure to submit a proper quotation to enable the Consultant to expeditiously process the quotation and issue a Change Order will not be grounds for any additional change to Contract time.
 - .5 If, in your opinion, changes or revisions to the work should be made, inform the Consultant in writing and, if the Consultant agrees a Notice of Change will be issued.
 - .6 Do not execute any change or revision until written authorization for the change or revision has been obtained

1.18 SCAFFOLDING, RIGGING, AND HOISTING

- .1 Unless otherwise specified or directed, supply, erect and operate all scaffolding, rigging, hoisting equipment and associated hardware required for your work. Immediately remove from the site all scaffolding, rigging, and hoisting equipment when no longer required.

1.19 PROJECT CLOSEOUT SUBMITTALS

- .1 Prior to application for Substantial Performance, submit all required items and documentation specified, including the following:
 - .1 Operating and Maintenance Manuals
 - .2 as-built record drawings and associated data
 - .3 extended warranties for equipment as specified
 - .4 all operating test certificates, i.e. Fire Alarm System Test Certificate
 - .5 identified keys for electrical equipment and/or panels for which keys are required, and all other items required to be submitted

.6 other data or products specified

- .2 **Operating and Maintenance Manuals:** Submit three hard copies of operating and maintenance manuals consolidated in hardcover three "D" ring binders, each binder sized to include approximately 25% spare space for future data, and identified permanently with the Project name, "ELECTRICAL OPERATING AND MAINTENANCE MANUAL" wording, and the date. Manuals are to include the following:
- .1 an Introduction sheet listing the Consultant's, Contractor's, and Subcontractor names, street addresses, telephone and fax numbers, and e-mail addresses
 - .2 a Table of Contents sheet, and corresponding index tab sheets
 - .3 a copy of each "Reviewed" or "Reviewed As Modified" shop drawing or product data sheet, with manufacturer's/supplier's name, telephone and fax numbers, email address, and the email address for local source of parts and service
 - .4 test reports, and certificates issued by governing authorities
 - .5 **Operating Data:** Operating data is to include:
 - .1 a description of each system and its controls
 - .2 operation instruction for each system and each component
 - .3 description of actions to be taken in event of emergencies and/or equipment failure
 - .6 **Maintenance Data:** Maintenance data is to include:
 - .1 servicing maintenance, operation and trouble-shooting instructions for each item of equipment and each system
 - .2 schedules of tasks, frequency, tools required, and estimated task time
 - .3 complete parts list with numbers
 - .7 **Performance Data:** Performance data is to include:
 - .1 equipment and system start-up data sheets
 - .2 equipment performance verification test results, and final commissioning report
 - .8 **Review Submittal:** Assemble one copy of the O & M Manual and submit to the Consultant for review prior to Owner training and instructions, and assembling the remaining copies. Incorporate all comments into the final submission.
 - .9 **Digital O & M Manuals:** Submit four digital versions of the hard copy manual using the latest version of Adobe Acrobat Portable Document Format and enhanced with bookmarks, internet links, and internal document links. The

digital copies are to be copied to CDR with custom labels which indicate the project name, date, the Consultant's name, and "Operating & Maintenance Manual for Electrical Systems".

- .3 **Record "As-Built" Drawings and Data:** As work progresses at the site, clearly mark in red in a neat and legible manner on a set of white prints of the Contract Drawings, all significant changes and deviations from the routing of services and locations of equipment shown on the Contract Drawings and resulting from the issue of Addenda, Site Instructions, Change Orders, and job conditions. Use notes marked in red as required.
Maintain the white print red line as-built set at the site for the exclusive use of recording as-built conditions, keep the set up-to-date at all times, and ensure that the set is always available for periodic review. The as-built set is also to include the following:
 - .1 the dimensioned location of all inaccessible concealed work
 - .2 the locations of control devices with identification for each
 - .3 the location of all junction boxes, terminal cabinets, etc.
 - .4 for underground conduit, ducts, etc., record dimensions, invert elevations, all offsets, fittings, and accessories if applicable, and locate dimensions from benchmarks that will be preserved after construction is complete
 - .5 the location of all concealed services terminated for future extension
 - .6 **Digital Record "As-Built" Drawings:** When work on site is complete, transfer all the as-built red line information from the site as-built drawings to a recordable and identified digital media containing Revit 2016 file format with AutoCAD 2010 export and PDF format. All work of equal quality to the Contract Drawings. Obtain a digital file containing Contract Drawings as described below.
 - .7 **Obtaining Digital Copies:** The electrical drawings have been prepared in Revit 2016 format. For the purpose of producing final as-built drawings, digital copies of the Contract Drawings will be supplied free of charge by the Consultant.
 - .8 **Review and Submittal:** Prior to inspection for Substantial Performance of the work, submit for review, the red line site as-built white prints, digital media containing as-built drawings, and a bound set of white prints (of equal quality to the Contract Drawings). The Consultant will review the drawings and, if necessary, return the disc and the marked-up white prints for corrections or further revisions, in which case complete the corrective and/or revision work and resubmit the media and white prints until they are determined to be acceptable, all prior to issue of a Certificate of Substantial Performance.

1.20 PROGRESS PAYMENT BREAKDOWN

- .1 Submit, prior to submittal of the first progress payment draw, a breakdown of the cost of the electrical work to assist the Consultant in reviewing and approving monthly progress payment claims.
- .2 The payment breakdown is subject to the Consultant's approval and progress payments will not be processed until an approved breakdown is in place. The breakdown is to include one-time claim items such as mobilization and

demobilization, insurance, bonds (if applicable), shop drawings and product data sheets, commissioning, and project closeout submittals.

1.21 REQUIREMENTS FOR CONTRACTOR RETAINED ENGINEERS

- .1 All professional engineers retained by you to perform consulting services with regard to your work, i.e. structural engineer, are to be members in good standing with the local Association of Professional Engineers, and are to carry and pay for errors and omissions professional liability insurance in compliance with requirements of the governing authorities in the locale of the work.
- .2 Your engineer's professional liability insurance is to protect your Consultants and Sub- Consultants, and their respective servants, agents, and employees against any loss or damage resulting from the professional services rendered by your Consultants, Sub- Consultants, and their respective servants, agents, and employees in regards to the work of this Contract.
- .3 Liability insurance requirements are as follows:
 - .1 coverage is to be a minimum of \$1,000,000.00 inclusive of any one occurrence
 - .2 the insurance policy is not to be cancelled or changed in any way without the insurer giving the Owner a minimum of thirty days written notice
 - .3 liability insurance is to be obtained from an insurer registered and licensed to underwrite such insurance in the location of the work
 - .4 evidence of the required liability insurance in such form as may be required is to be issued to the Owner, the Owner's Consultant, and Municipal Authorities as required prior to commencement of your Consultant's services

1.22 EXTENDED WARRANTIES

- .1 Unless otherwise specified, all extended warranties specified in electrical work Sections of the Specification are to be full parts and labour warranties, at the site, and in accordance with requirements of the Contract warranty, but direct from the equipment manufacturer/supplier to the Owner. Submit signed and dated copies of extended warranties which clearly state requirements specified above.

1.23 EQUIPMENT AND MATERIAL MANUFACTURER REQUIREMENTS

- .1 Equipment and materials scheduled or specified on the drawings or in the Specification have been selected to establish a performance and quality standard.
- .2 In most cases acceptable equipment and material manufacturers are listed for any product specified by manufacturer's name and model number. Unless otherwise stated the bid price may be based on products supplied by any of the manufacturers named as acceptable for the particular product. If acceptable manufacturers are not listed for a particular product, base the bid price on the products supplied by the specified manufacturers.
- .3 If products supplied by a manufacturer named as acceptable are used in lieu of the products specified by manufacturer's name and model number, ensure that the product is equivalent in performance and operating characteristics (including energy efficiency if applicable) to the specified product. Pay for any additional costs and changes to associated or adjacent work resulting from the use of products supplied by a manufacturer other than the specified manufacturer. In addition, in equipment

spaces where products named as acceptable are used in lieu of the specified products and the dimensions of such products differ from the specified products prepare and submit for review, if requested, accurately dimensioned layouts of the rooms affected to prove that all the equipment in the room will fit properly.

1.24 LIST OF ACCEPTABLE MANUFACTURERS AND SUPPLIERS

- .1 Within one day after award of a Contract, submit to the Consultant for review, a list to indicate the name of the manufacturers/suppliers you propose to use for each item of equipment, material, or service listed, except for items such as conduit, branch circuit conductors, and similar products. Manufacturers and/or suppliers on the list must be named in the Specification or on the drawings.
- .2 If the List of Acceptable Manufacturers and Suppliers is not submitted within one day after award of a Contract, the products specified and scheduled by manufacturer's name and model number and on which the Project is based are to be supplied. No substitutions whatsoever will be accepted unless previously approved in writing by the Consultant.
- .3 If a Supplementary Bid Form is issued with the Bid Documents and requests the list of acceptable manufacturers and suppliers, the completed Supplementary Bid Form is to be submitted within one day after the date for bid closing.

1.25 SUBSTITUTED OR ALTERNATIVE PRODUCTS

- .1 Products supplied by a manufacturer/supplier other than a manufacturer specified as acceptable may be considered for acceptance by the Consultant if requested in writing a minimum of five full working days prior to the bid closing date. Requests may be made by letter, or by email. Telephone requests will not be considered.
- .2 Each request for acceptance of a proposed substitution or alternative product must be accompanied by detailed catalogue and engineering data, fabrication information, and performance characteristics to permit the Consultant to make an informed decision.
- .3 Pay for any additional costs and changes to associated or adjacent work resulting from the use of products supplied by a substituted or alternative manufacturer. In addition, in equipment spaces where substituted or alternative products are used in lieu of the specified or acceptable products and the dimensions of such products differ from the specified or acceptable products, prepare and submit for review, if requested, accurately dimensioned layouts of the rooms affected to prove that all the equipment in the room will fit properly.
- .4 The Consultant's decision regarding any proposed substitution or alternative product is final.

1.26 PHASING OF THE WORK

- .1 Phasing of the work is required to maintain the existing building in operation, all as specified in Division 01. Include all costs for phasing the work including all required "off hours" premium time labour costs.

1.27 EQUIPMENT AND SYSTEM MANUFACTURER'S CERTIFICATION

- .1 When equipment/system installation is complete, but prior to start-up procedures, arrange and pay for the equipment/system manufacturer's authorized representative to visit the site to examine the installation, and when any required corrective measures have been made, to certify in writing to the Consultant that the equipment/system installation is complete and in accordance with the equipment/system manufacturer's instructions.

1.28 EQUIPMENT AND SYSTEM START-UP

- .1 When installation of equipment/systems is complete but prior to commissioning, perform start-up for equipment/systems as specified in electrical work Sections in accordance with the following requirements:
 - .1 submit a copy of each equipment/system manufacturer's start-up report sheet to the Consultant for review, and incorporate any comments
 - .2 under direct on-site supervision and involvement of the equipment/system manufacturer's representative, start-up the equipment/systems, make any required adjustments, document the procedures, leave the equipment/systems in proper operating condition, and submit a complete set of start-up documentation sheets signed by the manufacturer/supplier and the Contractor

1.29 EQUIPMENT AND SYSTEM COMMISSIONING

- .1 After successful start-up and prior to Substantial Performance, commission the electrical work using approved commissioning sheets. Submit final commissioning data sheets.
Include for equipment manufacturer's representation at the site to assist in the commissioning process

1.30 EQUIPMENT AND SYSTEM O & M DEMONSTRATION & TRAINING

- .1 Refer to equipment and system operational and maintenance training requirements specified in Division 01.
- .2 Train the Owner's designated personnel in all aspects of operation and maintenance of equipment and systems as specified in electrical work Sections of the Specification. All demonstrations and training is to be performed by qualified technicians employed by the equipment/system manufacturer/supplier.
- .3 For each item of equipment and for each system for which training is specified, prepare training modules as specified below. Operating and Maintenance Manuals are to be used during the training sessions, and training modules are to include:
 - .1 **Operational Requirements and Criteria:** requirements and criteria are to include but not be limited to equipment function, stopping and starting, safeties, operating standards, operating characteristics, and limitations
 - .2 **Troubleshooting:** troubleshooting is to include but not be limited to diagnostic instructions, test and inspection procedures
 - .3 **Documentation:** documentation is to include but not be limited to equipment/system warranties, and manufacturer's/supplier's parts and service facilities, telephone numbers, email addresses, and the like
 - .4 **Maintenance:** maintenance requirements are to include but not be limited to inspection instructions, types of cleaning agents to be used as well as cleaning methods, preventive maintenance procedures, and use of any

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special tools

- .5 **Repairs:** repair requirements are to include but not be limited to diagnostic instructions, disassembly, component removal and repair instructions, instructions for identifying parts and components, and review of any spare parts inventory
- .4 Assemble the training modules into a training manual and submit a copy to the Consultant for review prior to scheduling training. Ensure that each participant in each training session has all required training material.
- .5 Schedule demonstrations and training at mutually agreed to times with a minimum of 7 working days notice.
- .6 **Demonstration and Training Confirmation:** Obtain a list of personnel to receive demonstration and training from the Consultant, and have each participant sign the list to confirm that he/she understood the demonstration and training session.

PART 2. - PRODUCTS

2.1 NOT APPLICABLE

PART 3. - EXECUTION

3.1 NOT APPLICABLE

END OF SECTION

1	GENERAL	1
1.2	SUBMITTALS	1
1.3	REFERENCE STANDARD.....	1
2	PRODUCTS	1
3	EXECUTION	1
3.2	HAZARDOUS MATERIALS AND WASTE.....	2
3.3	INTERRUPTION TO AND SHUT-DOWN OF ELECTRICAL SERVICES AND SYSTEMS	2
3.4	ROOFING WORK	2

1 GENERAL

1.1 APPLICATION

- .1 This Section specifies requirements, criteria, methods and execution for electrical demolition work that are common to one or more electrical work Sections, and it is intended as a supplement to each Section and is to be read accordingly.

1.2 SUBMITTALS

- .1 Submit documentation to confirm that all PCB material and/or equipment containing PCB material has been properly removed and disposed of as applicable.

1.3 REFERENCE STANDARD

- .1 Perform demolition work in accordance with requirements of CAN/CSA-S350, Code of Practice for Safety in Demolition of Structures.

2 PRODUCTS

Not Applicable

3 EXECUTION

3.1 DISCONNECTION AND REMOVAL OF EXISTING ELECTRICAL WORK

- .1 Where indicated on the drawings, disconnect and remove existing electrical work, including hangers, supports, etc. Disconnect at the point of supply, remove obsolete connecting services and make the system safe. Cut back obsolete conduit behind finishes and cap unless otherwise specified.
- .2 The scope and extent of the demolition or revision work is only generally indicated on the drawings. Estimate the scope, extent and cost of the work at the site during the bidding period scheduled site visit(s).
- .3 Where deemed necessary by the Owner and Consultant, existing shafts, walls, and inaccessible ceilings will be opened by the Owner to permit site visit inspection of services to be removed/revised as part of the work but usually concealed behind such construction.
- .4 Claims for extra costs for demolition work not shown or specified but clearly visible or ascertainable at the site during bidding period site visits will not be allowed.
- .5 If any re-design is required due to discrepancies between the electrical drawings and site conditions, notify the Consultant who will issue a Site Instruction. If, in the opinion of the Consultant, discrepancies between the electrical drawings and actual site conditions are of a minor nature, the required modifications are to be done at no additional cost.
- .6 Where existing electrical services extend through, or are in an area to serve items

which are to remain, maintain the services in operation. Include for rerouting existing services concealed behind existing finishes and which become exposed during the renovation work, so as to be concealed behind new or existing finishes.

- .7 Unless otherwise specified, remove from the site and dispose of all existing materials which have been removed and are not to be relocated or reused.
- .8 Unless otherwise specified, remove from the site and dispose of all existing materials which have been removed and are not to be relocated or reused, except for the following which are to be handed over to the Owner at the site:
 - .1 Light fixtures
 - .2 Electrical devices, panels and cabinets.

3.2 HAZARDOUS MATERIALS AND WASTE

- .1 If hazardous materials and/or waste not listed in the Specification is found, stop the associated work and notify the Owner and Consultant immediately and await directions.

3.3 INTERRUPTION TO AND SHUT-DOWN OF ELECTRICAL SERVICES AND SYSTEMS

- .1 Co-ordinate all shut-down and interruption to existing electrical systems with the Owner.
Generally, shut-downs may be performed only between the hours of 12:00 midnight Friday until 6:00 a.m. Monday morning.
- .2 Upon award of contract, submit a list of anticipated shut-down times and their maximum duration.
- .3 Prior to each shut-down or interruption, inform the Owner in writing seventy-two hours in advance of the proposed shut-down or interruption and obtain written approval to proceed. Do not shut-down or interrupt any system or service without such written approval.
- .4 Perform work associated with shut-downs and interruptions as continuous operations to minimize the shut-down time and to reinstate the systems as soon as possible, and, prior to any shut-down, ensure that all materials and labour required to complete the work for which the shut-down is required are available at the site.

3.4 ROOFING WORK

- .1 Where roof revisions and/or replacements are part of the project, include for disconnecting, lifting, or temporarily removing electrical equipment and electrical connections to other roof mounted equipment as required to permit completion of the roofing work, and for re-installing/re-connecting the equipment when the roofing work is complete.

END OF SECTION

1	GENERAL.....	1
1.2	SUBMITTALS	1
1.3	REFERENCE STANDARD.....	1
2	PRODUCTS	1
3	EXECUTION.....	1
3.2	HAZARDOUS MATERIALS AND WASTE	2
3.3	INTERRUPTION TO AND SHUT-DOWN OF ELECTRICAL SERVICES AND SYSTEMS	2
3.4	ROOFING WORK.....	2

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1.1 APPLICATION

- .1 This Section specifies requirements, criteria, methods and execution for electrical demolition work that are common to one or more electrical work Sections, and it is intended as a supplement to each Section and is to be read accordingly.

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1.3 REFERENCE STANDARD

- .1 Perform demolition work in accordance with requirements of CAN/CSA-S350, Code of Practice for Safety in Demolition of Structures.

2 PRODUCTS

Not Applicable

3 EXECUTION

3.1 DISCONNECTION AND REMOVAL OF EXISTING ELECTRICAL WORK

- .1 Where indicated on the drawings, disconnect and remove existing electrical work, including hangers, supports, etc. Disconnect at the point of supply, remove obsolete connecting services and make the system safe. Cut back obsolete conduit behind finishes and cap unless otherwise specified.
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- .3 Where deemed necessary by the Owner and Consultant, existing shafts, walls, and inaccessible ceilings will be opened by the Owner to permit site visit inspection of services to be removed/ revised as part of the work but usually concealed behind such construction.
- .4 Claims for extra costs for demolition work not shown or specified but clearly visible or ascertainable at the site during bidding period site visits will not be allowed.
- .5 If any re-design is required due to discrepancies between the electrical drawings and site conditions, notify the Consultant who will issue a Site Instruction. If, in the opinion of the Consultant, discrepancies between the electrical drawings and actual site conditions are of a minor nature, the required modifications are to be done at no additional cost.

- .6 Where existing electrical services extend through, or are in an area to serve items which are to remain, maintain the services in operation. Include for rerouting existing services concealed behind existing finishes and which become exposed during the renovation work, so as to be concealed behind new or existing finishes.
- .7 Unless otherwise specified, remove from the site and dispose of all existing materials which have been removed and are not to be relocated or reused.
- .8 Unless otherwise specified, remove from the site and dispose of all existing materials which have been removed and are not to be relocated or reused, except for the following which are to be handed over to the Owner at the site:
 - .1 Light fixtures
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- .4 Perform work associated with shut-downs and interruptions as continuous operations to minimize the shut-down time and to reinstate the systems as soon as possible, and, prior to any shut-down, ensure that all materials and labour required to complete the work for which the shut-down is required are available at the site.

3.4 ROOFING WORK

- .1 Where roof revisions and/or replacements are part of the project, include for disconnecting, lifting, or temporarily removing electrical equipment and electrical connections to other roof mounted equipment as required to permit completion of the roofing work, and for re-installing/re-connecting the equipment when the roofing work is complete.

END OF SECTION

1	GENERAL	1
2	PRODUCTS	1
2.2	LOW VOLTAGE (24 VOLT) CONDUCTORS	1
2.3	CONNECTORS	2
2.4	CONDUCTOR PULLING LUBRICANT	2
3	EXECUTION	2
3.2	INSTALLATION OF DISTRIBUTION AND BRANCH CIRCUIT CONDUCTORS	2

1 GENERAL

1.1 SUBMITTALS

- .1 **Product Data:** Submit product data sheets for all products specified in this Section. IndicWate compatibilities and limitations, and application instructions.
- .2 **Samples:** If requested, submit identified conductor samples.
- .3 **MSDS Sheets:** Submit Material Safety Data Sheets for conductor pulling lubricants.

2 PRODUCTS

2.1 DISTRIBUTION AND BRANCH CIRCUIT CONDUCTORS

- .1 Conductors to and including No. 10 AWG are to be solid. Conductors larger than No. 10 AWG are to be stranded. All conductors are to be constructed from 98% conductive copper and are to be approved for 600 volts. Conductors are to be colour coded, factory identified on the insulation with the manufacturer's name, conductor size and metal, voltage rating, and CSA type and designation. Conductors are to be as follows:
 - .1 "T-90 Nylon" single conductor in accordance with CSA C22.2 No. 75, Thermoplastic-Insulated Wires and Cables, 90° C (195° F) rated, PVC insulated and nylon covered
 - .2 "RW-90" single conductor in accordance with CAN/CSA C22.2 No. 38, Thermoset- Insulated Wires and Cable, 90° C (195° F) rated, X-link polyethylene insulated
 - .3 "TWU" single conductor in accordance with CSA C22.2 No. 75, -40° C (-40° F) rated, PVC insulated
 - .4 "AC90" flexible cable to CSA C22.2 No. 51, Armoured Cable, with 90° C (195° F) rated, X-linked polyethylene insulated conductors, a concentric ground conductor, and an interlocking aluminium armour jacket
 - .5 "A90 ISO-BX" flexible cable to CSA C22.2 No. 51, Armoured Cable, with 90° C (195° F) rated, X-linked polyethylene insulated conductors, a concentric bare ground conductor, an insulated ground conductor, and an interlocking aluminium armour jacket

2.2 LOW VOLTAGE (24 VOLT) CONDUCTORS

- .1 "T-90" or "RW90" stranded copper conductors as specified above.
- .2 Equal to Nexans Canada "Securex II" FAS/LVT/FT1300 volt wire to CSA C22.2 No. 208, Fire /Alarm and Signal Wire, 105° C (220° F) rated, consisting of solid copper conductors (stranded for control wiring), flame retardant PVC insulation, an aluminium/Mylar optional shield with a #22 AWG tinned copper insulation and a drain wire, and, if required for the application, interlocking aluminium armour with or without an overall jacket.

2.3 CONNECTORS

- .1 **Conductors In Conduit:** Except as noted, equal to Ideal Industries Inc. "Wing Nut" CSA certified, 60 volt rated pressure type twist connectors.
- .2 **Conductors 3/0 AWG and Larger:** Long barrel, double crimp, compression type lug connectors, unless otherwise specified.
- .3 **Armoured Cable:** Except as noted, proper squeeze type connectors and plastic anti-short bushings at terminations in accordance with requirements of CSA C22.2 No. 18.3, Conduit, Tubing and Cable Fittings.

2.4 CONDUCTOR PULLING LUBRICANT

- .1 Equal to Ideal Industries Inc. "Yellow 77" or "ClearGlide", as required.

3 EXECUTION

3.1 Conform to the following conductor installation requirements:

- .1 **Conductor Routing:** Conductor routing indicated on the drawings is schematic and approximate. Determine exact routing and conductor lengths at the site. Route conductors to avoid interference with other work. Unless otherwise specified or shown install conductors parallel to building lines.
- .2 **Conductor Pulling:** When pulling conductors into conduit use lubricant and ensure that the conductors are kept straight and are not twisted.
- .3 **Securing/Supporting Conductors:** Conform to the following requirements:
 - .1 neatly secure exposed conductors in equipment enclosures with proper supports and/or ties
 - .2 support flexible armoured cable in ceiling spaces and stud walls with steel two hole cable straps to Code requirements
- .4 **Conductor Splicing:** Generally conductor splicing is not permitted unless otherwise approved by the Consultant, and if approved splicing is subject to the following conditions:
 - .1 splicing is permitted to extend existing conductors
 - .2 for thermoplastic insulated conductors, splices are to be made within an approved electrical box with mechanical compression connectors to suit the type and size of conductors, and the box(es) are to be properly identified and locations are to be indicated on "as-built" drawings
 - .3 do not splice "Corflex" cable unless justified by cable pulling tension calculations and when approved by the Consultant, and, if approved, locate splices where directed by the Consultant

3.2 INSTALLATION OF DISTRIBUTION AND BRANCH CIRCUIT CONDUCTORS

- .1 Provide all required conductors.

- .2 **Non-Fire Rated Conductors:** Unless otherwise specified herein or on the drawings, non-fired rated conductors are to be used as follows:
 - .1 conductors underground inside or outside the building, and in non-climate controlled areas – **TWU**
 - .2 unless otherwise specified, conductors in accessible ceiling spaces, within stud wall construction, and in furniture systems to luminaries and wiring devices – **AC90 (BX) flexible armoured cable, maximum 3 m (10') run permitted**
 - .3 for isolated power system wiring – **RW90**
 - .4 for patient care area conductors in accessible ceiling spaces (not walls) to luminaries- **AC90 (BX) flexible armoured cable, maximum 3 m (10') run permitted**
 - .5 for conductors in medical headwalls and service consoles, and as per drawing details – **T90 Nylon or RW90 in flexible conduit, or AC90 ISO-BX to Code requirements**
 - .6 for conductors except as specified above or elsewhere in the Specification or on the drawings – **T90 Nylon or RW90**
- .3 **Conductor Sizing:** Generally, conductor sizes are indicated on the drawings. Unless otherwise specified, do not use conductors smaller than No. 12 AWG in systems over 30 volts. Unless otherwise specified, do not use conductors smaller than No.6 AWG for exterior luminaire wiring. Conductor sizes indicated on the drawings are minimum sizes and must be increased, where required, to suit length of run and voltage drop in accordance with the voltage drop schedule found at the end of this Section.
- .4 **Conductor Colour Coding:** Unless otherwise specified, colour code conductors to identify phases, neutral, and ground by means of self-laminating coloured vinyl tape, coloured conductor insulation, or properly coloured plastic discs. Colours are to be as follows:
 - .1 phase A – red
 - .2 phase B – black
 - .3 phase C – blue
 - .4 neutral – white
 - .5 control – orange
- .5 **Isolated Power System Colour Coding:** Colour code isolated power system “load” side power wiring insulation as follows:
 - .1 live No. 1 – brown
 - .2 live No. 2 – orange
 - .3 ground – green
- .6 **Communication System Colour Coding:** Unless otherwise specified, colour code conductors for communication systems in accordance with the system manufacturer’s recommendations.

MAX. BRANCH WIRING DISTANCE FOR 120 VOLT SYSTEM AT 3% VOLTAGE DROP

Wire Size	Breaker Size (AMPERES)	15	20	30	40	50	60	70	80	100
	MAX LOAD AT 80% (AMPERES)	12	16	24	32	40	48	56	68	80
No 12.	-----	24.4	18.3	-----	-----	-----	-----	-----	-----	-----
No 10	-----	38.1	29.0	19.1	-----	-----	-----	-----	-----	-----
No. 8	-----	59.4	44.2	30.5	22.9	-----	-----	-----	-----	-----
No. 6	-----	91.4	70.1	47.2	35.1	28.2	23.6	-----	-----	-----
No.4	-----	-----	109.7	73.2	54.9	42.7	38.1	32.0	27.4	-----
No. 2	-----	-----	-----	114.3	85.3	68.6	57.9	50.3	41.1	35.0
No. 1	-----	-----	-----	-----	103.6	85.3	73.2	61.0	54.9	43.4
No.1/0	-----	-----	-----	-----	128.0	102.9	85.3	73.2	64.0	48.8
No. 2//0	-----	-----	-----	-----	-----	122.9	100.6	86.9	74.7	60.9
No. 3/0	-----	-----	-----	-----	-----	-----	118.1	102.1	88.4	70.1
No. 4/0	-----	-----	-----	-----	-----	-----	-----	120.4	102.9	83.8
250 MCM	-----	-----	-----	-----	-----	-----	-----	-----	114.3	91.4
300 MCM	-----	-----	-----	-----	-----	-----	-----	-----	-----	103.6

NOTE: DISTANCES INDICATED IN METRES FROM PANEL TO LOAD FOR SINGLE PHASE

END OF SECTION

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2	PRODUCTS.....	1
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2.3	GROUND MAT	1
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2.5	GROUND PIT	2
2.6	FLEXIBLE GROUND BRAID	2
2.7	GROUND CONDUCTORS	2
2.8	GROUNDING AND BONDING CONNECTIONS.....	2
2.9	COMMUNICATIONS, ACCESS CONTROL, & ELECTRONIC SAFETY SYSTEM GROUND BUS..	2
2.10	LAN ROOM GROUND BUS	2
3	EXECUTION	2
3.2	INSTALLATION OF GROUND ROD GRIDS	3
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3.4	NEUTRAL GROUNDING.....	3
3.5	POLE MOUNTED SWITCHING DEVICE GROUNDING	3
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3.7	ELECTRICAL MANHOLE GROUNDING	4
3.8	CABLE SHEATH GROUNDING.....	4
3.9	LOCAL AREA NETWORK (LAN) ROOM GROUNDING.....	4
3.10	TELECOMMUNICATIONS SYSTEMS GROUNDING	4

1 GENERAL

1.1 SUBMITTALS

- .1 **Product Data:** Submit product data sheets for all products specified in Part 2 of this Section except for copper wire/cable conductors.

1.2 QUALITY ASSURANCE

- .1 Grounding and bonding work is to be in accordance with requirements of the following:
 - .1 CSA C22.2 No. 41, Grounding and Bonding Equipment (Tri-National Standard with UL 467)
 - .2 CSA C22.2 No. 0.4, Grounding and Bonding of Electrical Equipment
 - .3 requirements of the Electrical Safety Authority and any other governing authority

1.3 COORDINATION

- .1 Coordinate the installation of grounding hardware and conductors associated with concrete with the trades providing the concrete work.

1.4 FIELD QUALITY CONTROL REPORT

- .1 Submit written and signed report(s) indicating successful results of the ground continuity tests specified in Part 3.

2 PRODUCTS

2.1 GROUND RODS

- .1 Copper clad solid steel round rods, 20 mm ($\frac{3}{4}$ " diameter, 3 m (10') long, each complete with driving cap, pointed bronze tip, and a #14 gauge hot dipped galvanized steel or PVC, 250 mm (10") diameter, 300 mm (12") long ground rod box with a vandal-proof removable identified cover.

2.2 GROUND PLATES

- .1 Copper plates, 1 m² (11 ft.² surface area, 6 mm ($\frac{1}{4}$ " thick.

2.3 GROUND MAT

- .1 Copper mesh gradient control mat, 1.5 m (5') square, 2 mm ($\frac{3}{32}$ " thick, 50 x 50 mesh.

2.4 GROUND BUS

- .1 Solid electrical grade copper, minimum 50 mm x 6 mm (2" x $\frac{1}{4}$), minimum 600 mm (24") long but with lengths as required (continuous lengths for health care and data centre projects), predrilled for two-hole lug connections, suitable for wall or backboard mounting and complete with corner angles, tamper-proof stainless steel hex head bolts, nuts, and spring lock washers, standoff insulators, and all connection hardware.

2.5 GROUND PIT

- .1 Cast iron or precast concrete pit with a removable identified cast concrete cover with recessed lifting handle to set flush with grade, a ground rod with clamps and grounding conductors as indicated, and a bottom section of clay sewer tile filled with clean crushed stone or gravel for pit drainage.

2.6 FLEXIBLE GROUND BRAID

- .1 Flat 98% conductivity tinned copper grounding braid with dimensions to suit the application.

2.7 GROUND CONDUCTORS

- .1 Unless otherwise specified and/or shown. Stranded un-tinned soft annealed copper wire, bare or green PVC insulated conforming to requirement of the Section entitled Wire and Box Connectors (0-1000volts).

2.8 GROUNDING AND BONDING CONNECTIONS

- .1 **Below Grade:** Equal to Erico International Corp. "CADWELD" exothermic welded connections.
- .2 **Above Grade:** Compression type connectors with zinc-plated fasteners and external tooth lock washers, or, if approved by the Consultant, exothermic Erico International Corp. "CADWELD" welded connections.

2.9 COMMUNICATIONS, ACCESS CONTROL, & ELECTRONIC SAFETY SYSTEM GROUND BUS

- .1 Solid electrical grade copper bus bars, minimum 6 mm x 20 mm (1/4" x 3/4") designed for mounting on the framework of open or cabinet enclosed equipment racks.

2.10 LAN ROOM GROUND BUS

- .1 Solid electrical Grade copper bus bars, 300 mm x 50 mm x 9 mm (12" x 2" x 3/8") with 8 drilled holes, suitable for wall mounting and equipped with standoff insulators.

3 EXECUTION

3.1 GENERAL RE: GROUNDING AND BONDING

- .1 Perform all required grounding and bonding work in accordance with the Contract Documents and requirements of governing Codes and Standards, including the Electrical Safety Authority.
- .2 Bond metallic conduits, boxes, cable tray, ducts, and non-current carrying metal parts of equipment together to form a continuous ground system. In electrical equipment rooms, solidly bond circuits, panelboards, conduits, equipment enclosures, and other equipment to perimeter ground bus using bronze connectors and hardware.
- .3 Protect exposed conductors from injury. Install underground conductors a minimum of 450 mm (18") below grade.

- .4 Use tinned copper conductors for aluminium structures.
- .5 Do not use bare copper conductors adjacent to un-jacketed lead sheath cables.

3.2 INSTALLATION OF GROUND ROD GRIDS

- .1 Construct ground rod grids consisting of copper clad steel ground rods as indicated/specified where indicated, each consisting of the number of rods shown, driven into the earth a minim of 300 mm (12") below grade and terminated with a galvanized steel box enclosing the ground conductor clamp, and interconnected with minimum #3/0 AWG bare copper conductor. Flush with grade at each ground rod, provide an

3.3 INSTALLATION OF GROUND BUS

- .1 Provide ground bus where shown/specified. Wall mount 300 mm (12") above finished floor level on standoff insulators and follow the outline of door frames and room corners using 90° bus angles to form continuous bus. Connect the ground bus to the ground rod grid by means of two minimum #3/0 copper conductors terminated with approved fittings.
- .2 Provide flexible braided copper ground straps from the ground bus to each steel door frame and door in the room, each securely bolted in place.
- .3 Tighten all bus bar joint connection bolts and lug using a torque wrench to the bus manufacturer's prescribed tension, then coat the bus with two 100% covering coats of shellac to prevent copper oxidization.

3.4 NEUTRAL GROUNDING

- .1 Connect transformer neutral and distribution neutral together using 1000 volt insulated conductor to one side of a ground test link, the other side of the test link being connected directly to the main station ground. Ensure that distribution neutral and neutrals of potential transformers and service banks are bonded directly to the transformer neutral and not to the station ground.
- .2 Connect the neutral of the station transformer to the main neutral bus with a tap of the same size as the secondary neutral.
- .3 Ground the transformer tank with a continuous conductor from the tank ground lug through the connector on the ground bus to the primary neutral. Connect the neutral bushing at the transformer to the primary neutral in the same manner.

3.5 POLE MOUNTED SWITCHING DEVICE GROUNDING

- .1 Provide 4 ground rods at the base of each pole on which a group-operated line switching device is mounted. Locate the ground rods in a square grid formation such that the person operating the switch must stand within the formation.
- .2 Interconnect the ground rods with #2/0 AWG copper conductor and join to the switch operating handle ground wires.
- .3 Connect the operating handle of the switch to the handle base with #3/0 AWG extra-flexible copper conductor.

3.6 POLE MOUNTED TRANSFORMER GROUNDING

- .1 Provide ground rods at the base of each pole on which transformers are mounted and interconnect the rods with the transformers, system neutrals, and lightning arrestors.

3.7 ELECTRICAL MANHOLE GROUNDING

- .1 Provide a conveniently located ground stud, electrode, and ground conductor in each electrical manhole. Install the ground rod with the lug for the ground connection so that the top of the rod projects through the bottom of the manhole.

3.8 CABLE SHEATH GROUNDING

- .1 Bond single conductor metallic sheathed cables together at one end only. Break the sheath continuity in an approved manner, and provide #6 AWG flexible copper ground conductor soldered (not clamped) to the cable sheath.

3.9 LOCAL AREA NETWORK (LAN) ROOM GROUNDING

- .1 Provide minimum 3/0 AWG insulated copper ground conductors and wall mounted copper ground bus in each LAN Room. Connect the ground bus to computer equipment racks and to the building ground system.

3.10 TELECOMMUNICATIONS SYSTEMS GROUNDING

- .1 Provide all required conductors and hardware to properly ground and bond communication system raceways, cable tray, metallic cable shields, and equipment to a ground source in accordance with requirements of TIA/EIA-607, Commercial Building Grounding and Bonding Requirements for Telecommunications.

END OF SECTION

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1 GENERAL

1.1 SUBMITTALS

- .1 **Product Data:** If requested, submit product data sheets for products specified in this Section.
- .2 **Samples:** If requested, submit samples of products specified in this Section.

2 PRODUCTS

2.1 SPLITTER TROUGH

- .1 Formed #16 gauge steel Type 1 splitter trough in accordance with CSA C22.2 No. 76, Splitters, finished inside and outside with ANSI 61 gray heat cured powder epoxy paint, and complete with welded seams ground smooth, various size knockouts on each side, back mounting holes, removable doors with stainless steel hinges and hinge pins, terminal blocks for conductor connections, a single point ground lug
- .2 **Enclosures:** Unless otherwise specified, enclosures are to be in accordance with the following NEMA/EEMAC ratings:
 - .1 all enclosures located in sprinklered areas – Type 2
 - .2 all enclosures except as noted above – Type 1

2.2 PULL BOXES AND JUNCTION BOXES

- .1 Each box is to be CSA certified, sized to suit the number and size of conduit and conductors, and complete with connecting and securing facilities. Unless otherwise specified, pull boxes and junction boxes are to be as follows:
 - .1 galvanized or prime coat plated steel, suitable in all respects for the application and complete with screw-on or hinged covers as required and connectors suitable for the connected conduit
 - .2 “Condulet”, threaded galvanized cast iron or cast aluminium pull boxes and junction boxes of an exact type to suit the application, each complete with screw-on gasketed cover
 - .3 rigid plastic (PVC), junction boxes and access fittings with solvent weld type joints and screw-on PVC covers

3 EXECUTION

3.1 INSTALLATION OF SPLITTER TROUGH

- .1 Provide all required splitter trough in accordance with drawing plans, schedules, details, and requirements of the Specification.
- .2 Rigidly secure that the splitter trough in place, level and plumb.

- .3 Ensure that the splitter trough itself, and all branch circuits are properly identified.

3.2 INSTALLATION OF PULL BOXES AND JUNCTION BOXES

- .1 Provide pull boxes in conduit systems wherever shown on the drawings, and/or wherever necessary to facilitate conductor installations. Generally, conduit runs exceeding 30 m (100') in length, or with more than three 90° bends, are to be equipped with a pull box installed at a convenient and suitable intermediate accessible location.
- .2 Provide junction boxes wherever required and/or indicated on the drawings.
- .3 Unless otherwise specified, boxes are to be as follows:
 - .1 in rigid conduit and EMT inside the building – stamped galvanized or prime coated steel
 - .2 in exterior rigid conduit – “Condulet” cast aluminium gasketed boxes unless otherwise noted
 - .3 in plastic conduit – rigid PVC boxes
 - .4 in bronze underwater conduit – cast bronze boxes
- .4 All pull boxes and junction boxes must be accessible after the work is complete.
- .5 Accurately locate and identify all concealed pull boxes and junction boxes on “as-built” record drawings.
- .6 Cover boxes in fire walls with aluminium tape and seal with caulking.

END OF SECTION

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1 GENERAL

1.1 SUBMITTALS

- .1 **Product Data:** If requested, submit product data sheets for products specified in this Section.
- .2 **Samples:** If requested, submit samples of products specified in this Section.

2 PRODUCTS

2.1 OUTLET BOXES

- .1 Each box is to be CSA certified, suitable in all respects for the application, and be complete with suitable securing lugs, connectors suitable for the connected conduit, knockouts, and, where necessary, suitable plaster rings, concrete rings, covers and any other required accessory. Unless otherwise specified, outlet boxes are to be as follows:
 - .1 stamped, electro-galvanized steel outlet boxes
 - .2 rigid PVC outlet boxes

3 EXECUTION

3.1 INSTALLATION OF OUTLET AND CONDUIT BOXES

- .1 Provide an outlet box or back box for each luminaire, wiring device, telephone outlet, fire alarm system component, communications systems components, and all other such outlets.
- .2 **Stamped Galvanized Steel:** Outlet boxes flush mounted in interior construction, surface mounted in concealed interior locations, and surface mounted in exposed interior locations where the connecting conduit is EMT are to be stamped galvanized steel outlet boxes unless otherwise noted.
- .3 **"FS" and "FD" Series Boxes:** Outlet boxes for surface mounted for exterior lighting, receptacles, and other device outlets, boxes flush mounted in exterior building surfaces, and boxes mounted in interior device locations where the connecting conduit is rigid, and for boxes in perimeter walls where insulation and vapour barrier is present, are to be "FS" or "FD" Series cast boxes unless otherwise noted, cast iron inside the building, cast aluminium outside the building.
- .4 **Rigid PVC Boxes In New Concrete Slabs:** Provide rigid PVC outlet boxes in locations as follows:
 - .1 in underground polyethylene conduit systems
 - .2 for devices connected to isolated power system panelboards
 - .3 for rigid PVC conduit systems where permitted

- .5 Outlet boxes for special wiring devices, for special equipment and special applications if required, are specified hereinafter in other Sections or on the drawings.
- .6 The size and arrangement of outlet boxes are to suit the device which they serve.
- .7 Generally, mounting heights and locations for outlets are indicated on the drawings, however, confirm the exact location and arrangement of all outlets prior to roughing-in. Architectural drawings and the Consultant's instructions have precedence over electrical drawing diagrammatic layouts and specified mounting height and locations. In addition, abide by the following requirements:
 - .1 locate flush mounting boxes in masonry walls to require cutting of the masonry unit corner only, and coordinate masonry cutting to achieve a neat opening
 - .2 position outlet boxes to locate luminaires as shown on reflected ceiling plans
 - .3 coordinate mounting heights and locations of outlets mounted above counters, benches and backsplashes
- .8 Do not install outlet or back boxes "back-to-back" in walls and partitions. Stagger such outlets and seal against noise transmission with acoustic insulation. "Thru-wall" type boxes will not be permitted for any application.
- .9 Where boxes are multi-ganged or grouped together, mount boxes level and spaced consistently.
- .10 Temporarily pack all open boxes located in concrete and masonry to prevent debris from entering the box.
- .11 Include all costs for installed boxes that have not been covered by wall/ceiling finishes, to be relocated up to 3 m (10') to suit final device location coordination.
- .12 Provide blank coverplates over all boxes left empty for future installation of devices. Clearly identify each box as to its intended use to the Consultant's approval. Generally, blank coverplates are to be stainless steel.

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1 GENERAL

1.1 SUBMITTALS

- .1 **Product Data:** Submit product data sheets for all products where submittal is specified in Part 2 or Part 3 of this Section.
- .2 **Colour Coated EMT Colour Chart:** Submit the colour coated EMT manufacturer's standard colour chart for colour selection(s) by the Consultant.

2 PRODUCTS

2.1 EMT

- .1 Galvanized steel to CSA C22.2 No. 83, Electrical Metallic Tubing, complete with factory made bends where site bending is not possible, and joints and terminations made with steel couplings and set screw type connectors, concrete tight where required.

2.2 RIGID GALVANIZED STEEL CONDUIT

- .1 Rigid galvanized steel to CSA C22.2 No. 45, Rigid Metal Conduit, with an enamel interior coating, galvanized threads where factory threaded, red lead coated threads where site threaded, factory made bends where site bending is not possible, factory made threaded fittings and connectors, and terminations made with rigid couplings, concrete tight where required.

2.3 EPOXY COATED-RIGID STEEL CONDUIT

- .1 With an enamel interior coating and an exterior standard green epoxy coating, galvanized threads where factory threaded, red lead coated threads where site threaded, factory made bends where site bending is not possible, factory made threaded fittings and connectors, and terminations made with rigid couplings, concrete tight where required.

2.4 FLEXIBLE GALVANIZED STEEL LIQUID-TIGHT CONDUIT

- .1 Flexible galvanized steel liquid-tight conduit to CSA C22.2 No. 56, Flexible Metal Conduit and Liquid-Tight Flexible Metal Conduit, complete with Ideal Industries Inc. "Steel Tough" liquid-tight connectors at terminations

2.5 FLEXIBLE GALVANIZED STEEL CONDUIT

- .1 Galvanized steel flexible conduit to CSA C22.2 No. 56, Flexible Metal Conduit and Liquid-Tight Flexible Metal Conduit, complete with proper and suitable squeeze type connectors at terminations.

2.6 RIGID PVC CONDUIT

- .1 Rigid PVC conduit to CSA C22.2 No. 211.1, Rigid Types EB1 and DB2/ES2 PVC Conduit, FT-4 rated, complete with site made heat gun bends for conduit to and including 50 mm (2") diameter, factory made fittings for conduit larger than 50 mm (2")

diameter, solvent weld joints, factory made expansion joints where required, and terminations made with proper and suitable connectors and adaptors.

2.7 FLEXIBLE PVC CONDUIT

- .1 Equal to Ipex Electrical Inc. "Cor-line" flexible, water-tight, corrugated PVC conduit with Ipex "Kwikon" fittings and ESU conduit supports spaced at every 600 mm to 900 mm (2' to 3"), and proper and suitable terminations and adaptors.

2.8 FLEXIBLE POLYETHYLENE CONDUIT

- .1 Polyethylene pipe to CSA-B137.1, Polyethylene (PE) Pipe, Tubing and Fittings For Cold Water Pressure Service, minimum Series 75, supplied in continuous coils of the proper length.

2.9 COLOUR COATED EMT

- .1 Equal to Allied Tube and Conduit "True Color" EMT as specified for standard EMT but factory coated with colours selected by the Consultant from the conduit manufacturer's standard colours.

2.10 FISH CORD

- .1 Polyethylene or nylon fish cord/tape with cable pull accessories to suit the application.

3 EXECUTION

3.1 GENERAL RE: INSTALLATION OF CONDUIT

- .1 Refer to the article entitled General Conduit and Conductor Installation Requirements in the electrical work Section entitled Basic Electrical Materials and Requirements.
- .2 Ensure that all open empty conduit ends are properly protected against dirt and debris during the construction process.

3.2 CONDUIT INSTALLATION REQUIREMENTS

- .1 Unless otherwise specified, provide conduit for all conductors except armoured cable, mineral insulated fire rated cable, and except where cable tray, cable duct, or a similar raceway is used.
- .2 **Conduit Types:** Conduit is to be as follows:
 - .1 for main distribution wiring in electrical rooms and similar areas – rigid galvanized steel
 - .2 for exposed conduit from floor level to 1.2 m (4') above the floor in mechanical and other service rooms – rigid galvanized steel
 - .3 for concealed conduit in exterior walls – rigid galvanized steel

- .4 for conduit exposed outside the building, except where rigid PVC conduit is permitted – rigid galvanized steel
 - .5 for short (minimum 450 mm (18”), maximum 600 mm (24”), with a 180° loop wherever possible) runs of conduit to electric motors, distribution transformers, and vibration isolated equipment – flexible galvanized steel liquid-tight conduit
 - .6 at points where exposed conduit crosses building expansion joints – flexible galvanized steel conduit
 - .7 for branch circuit conductors underground inside the building, and underground outside the building beneath structures and concrete or asphalt paving – rigid PVC
 - .8 for branch circuit conductors outside the building at roof level – rigid PVC
 - .9 for branch circuit conductors in concrete slabs on grade, and in concrete and masonry walls except exterior walls - rigid PVC
 - .10 for concealed branch circuit conductors associated with isolated power systems – rigid PVC
 - .11 for branch circuit conductors in concrete slabs above grade – flexible PVC
 - .12 for all conduit except as specified above – EMT
 - .13 for fire alarm system, and communications/security systems conductors – colour coated EMT with colours as selected
- .3 **Conduit Fittings:** Unless otherwise specified, conduit fittings are to be of the same material as the conduit and suitable in all respects for the application. Provide proper adaptors for joining conduit of different materials.
- .4 **Conduit Bends:** Site made bends for conduit must be made using proper bending equipment, bends must maintain the full conduit diameter with no kinking, and conduit finishes and lining must not flake or crack when the conduit is bent.
- .5 **Site Cutting Conduit:** Cut square and ream all site cut conduit ends.
- .6 **Conduit Threads:** Site cut rigid steel conduit using proper thread cutting equipment, in an approved area. Protect the area and building surfaces from being soiled/damaged by the threading process. Clean and lubricate threads and coat threads with red lead or other zinc rich coating.
- .7 **Conduit Sizes:** Generally, conduit is sized on the drawings. Conduit not sized on the drawings is to be sized in accordance with the governing Codes/Regulations. The sizes of branch circuit conductors shown/specified are minimum sizes and must be increased to suit length of run and voltage drop, and where this occurs, increase the conduit size to suit. Do not use conduit less than 19 mm (3/4”) diameter.
- .8 **Empty Conduit:** Ensure that all conduit left empty for future wiring is clean, capped, and properly identified. Provide end bushings and fish cord in all such conduit.
- .9 **Empty Conduit At Panelboards:** Where a suspended ceiling occurs, provide 4, empty,

20 mm ($\frac{3}{4}$ ") diameter conduits from each flush wall mounted panelboard terminated in the suspended ceiling above, capped and identified.

3.3 CONDUIT INSTALLED IN POURED CONCRETE

- .1 When and where conduit is permitted in structural poured concrete, abide by the following requirements:
 - .1 install the conduit in accordance with requirements of CAN/CSA-A23.1, Concrete Materials and Methods of Concrete Construction
 - .2 the conduit must be secured in a manner such that the concrete will not be displaced when the concrete is poured, and during the concrete pour, monitor the conduit installation to prevent displacement or damage, and immediately report any misplacement or damage observed
 - .3 where conduit extends adjacent to a column, stay away from the column a minimum of 2 times the thickness of the slab and drop away from the column
 - .4 where conduits terminate adjacent to a column or wall, bring the conduit in toward the column/wall as close to 90° to the face of the column/wall as possible
 - .5 where more than 2 conduits are adjacent to each other they are to be spaced the greater of 3 conduit diameters or 100 mm (4") apart
 - .6 the total depth of conduits crossing over each other is to be less than 1 third the thickness of the slab
 - .7 place conduit in the middle third of the slab thickness, and do not in any case lay conduit directly on reinforcing steel
 - .8 do not locate conduit adjacent to parallel reinforcing bars
 - .9 the maximum size of any conduit is $\frac{1}{5}$ th of slab thickness
 - .10 do not install conduit longitudinally in a beam without specific approval of the Consultant, and extend conduit through a beam at right angles to the beam span
 - .11 where conduits extend through beams stay a minimum of twice the depth of the beam away from the supports
 - .12 do not install conduit in the slab beside a drop or beam within twice the depth of the slab from the edge of the drop or beam
 - .13 do not install conduits through shear walls or columns without written approval from the consultant
 - .14 do not install conduit in parking garage structures, garage ramps, water retaining structures, or any other concrete subject to the application of de-icing products
 - .15 in areas where installation of conduit embedded in concrete is not permitted, extend conduit through beams in sleeves, if the installation of the

sleeves is permitted

- .16 slope all underground conduit to drainage points and ensure that the conduit can be drained

3.4 CONDUIT UNDER SLAB ON GRADE

- .1 Where conduit is to be installed under a slab on grade, the system is to be a pull-in system, must consider and address any effects of magnetic fields, and the following is to apply:
 - .1 concrete encased duct bank with non-ferrous conduits is to be used
 - .2 conduit is to be sloped to a proper drainage pit
 - .3 20% spare conduit (minimum 1) is to be provided

3.5 CONDUIT SUPPORT

- .1 **Underground Conduit:** Unless otherwise shown or specified, support underground conduit on a well tamped bed of earth or sand, free from rocks or protrusions of any kind.
- .2 **Surface Mounted & Suspended Single/Double Conduit Runs:** Support and secure single and double runs of conduit at support spacing in accordance with Code requirements by means of galvanized steel pipe straps, conduit clips, ring bolt type hangers with galvanized steel hanger rods, or by other approved manufactured devices.
- .3 **Support of Multiple Conduit Runs:** Support multiple conduit runs by means of Electrovert Ltd. "CANTRUSS" or Burndy Ltd. "FLEXIBLE" conduit racks and galvanized steel rods with support spacing to suit requirements of the smallest diameter conduit in the group.
- .4 **Conduit Expansion Facilities:** Abide by the following:
 - .1 wherever concealed or surface mounted conduit extends across a building expansion joint, provide expansion facilities to permit free movement without imposing additional stress or loading on the support system, and to prevent excessive movement at joints and connections
 - .2 provide manufactured expansion joint fittings in rigid PVC conduit at spacing recommended by the expansion joint fitting manufacturer
 - .3 make "snaked" bends in underground flexible polyethylene conduit

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1 GENERAL

1.1 SUBMITTALS

- .1 **Product Data:** Submit product data sheets for wiring devices. Ensure that the sheets indicate colours and faceplate finishes.

1.2 QUALITY ASSURANCE

- .1 All wiring devices are to be CSA certified as a minimum, in accordance with the following standards, as applicable:
 - .1 CAN/CSA C22.2 No. 42, General Use Receptacle, Attachment Plugs and Similar Wiring Devices
 - .2 CAN/CSA C22.2 No. 42.1, Cover plates for Flush Mounted Devices
 - .3 CSA C22.2 No. 111, General Use Snap Switches
- .2 Wherever possible, all wiring devices are to be supplied by the same manufacturer.
- .3 **Acceptable Manufacturers:** Unless otherwise specified in this Section or on the drawings, acceptable manufacturers are:
 - .1 Hubbell Canada LP
 - .2 Cooper Industries (Arrow Hart)
 - .3 Legrand/Pass & Seymour
 - .4 Leviton Canada

1.3 WIRING DEVICE AND PLATE COLOURS

- .1 Unless otherwise specified, wiring device colours will be stainless steel unless noted otherwise..

2 PRODUCTS

2.1 SWITCHES

- .1 Unless otherwise specified, Specification Grade, Premium Quality, back and side wired, 20 ampere, 120-277 volt A.C. quiet action toggle switches, single pole, 2-pole, 3-way, or key type as indicated on the drawings, each complete with a nickel plated steel ground terminal, brass power wiring terminals and screws, silver cadmium oxide contacts with a moveable brass contact arm, and nylon rectangular decorative rocker toggle with colour as specified below. Switch types are as follows:
 - .1 **Standard Wall Toggle Switches:** As above.
 - .2 **Explosion Proof Wall Switch (ON/OFF):** single throw double pole ON/OFF switch for wet well light circuit and vent fan circuit to be explosion proof (Class 1 – Zone 2 1 & 2. NEMA-3). Hubble CAT No. FXS-52C.

- .3 **Illuminated Handle Standard Wall Toggle Switch:** As above for standard switches but with a clear red or green polycarbonate toggle which is illuminated when the switch is on or off. Confirm toggle colour and position when illuminated prior to ordering.
- .4 **Illuminated Decorative Wall Rocker Switch:** Generally as specified above for decorative toggle switches but with a rocker type illuminated handle.
- .5 **Motor Control Snap Action Switch:** Illuminated handle snap action horsepower rated switch, CSA certified for motor control and sized to suit the application.
- .6 **Occupancy Sensor Switch:** Digital ultrasonic sensor type, 120-277 volt A.C. with integral photo sensor and selected to suit the area and occupancy of the room served.

2.2 SPECIFICATION GRADE STANDARD RECEPTACLES

- .1 Back or side wired, U-ground, 2 pole receptacles as follows:
 - .1 **15 Amp. 125 Volt Duplex Receptacle:** 3-wire receptacles, NEMA configuration 5- 15R
 - .2 **15 Amp. 250 Volt Duplex Receptacle:** 3-wire receptacles, NEMA configuration 6- 15R
 - .3 **20 Amp. 125 Volt Duplex Receptacle:** 3-wire receptacles, NEMA configuration 5- 20R
 - .4 **20 Amp. 250 Volt Duplex Receptacle:** 3-wire receptacles, NEMA configuration 6- 20R
 - .5 **30 Amp. 250 Volt Simplex Receptacle:** 3-wire receptacles, NEMA configuration 6- 30R
 - .6 **30 Amp. 125/250 Volt Simplex Receptacle:** 3-wire receptacles, NEMA configuration 14-30R
 - .7 **50 Amp. 250 Volt Simplex Receptacle:** 3-wire receptacles, NEMA configuration 6- 50R
 - .8 **50 Amp. 125/250 Volt Simplex Receptacle:** 4-wire receptacles, NEMA configuration 14-50R

2.3 SPECIFICATION GRADE LOCKING RECEPTACLES

- .1 Specification Grade, back or side wired, U-ground 2-pole, 3-wire locking type receptacles as follows:
 - .1 **15 Amp. 125 Volt Duplex Receptacle:** NEMA configuration L6-15R
 - .2 **15 Amp. 250 Volt Duplex Receptacle:** NEMA configuration L6-15R
 - .3 **20 Amp. 125 Volt Duplex Receptacle:** NEMA configuration L5-20R
 - .4 **20 Amp. 250 Volt Duplex Receptacle:** NEMA configuration L6-20R

2.4 SPECIFICATION GRADE ISOLATED GROUND RECEPTACLES

- .1 **20 Amp. 125 Volt Duplex Receptacle:** Back and side wired, duplex, U-ground, 2-pole, 20 ampere, 125 volt, 3-wire, orange colour, surge suppression isolated ground nylon construction receptacles, NEMA configuration 5-20R.

2.5 SPECIFICATION GRADE GROUND FAULT RECEPTACLES

- .1 Heavy-duty, 15/20 ampere, 125 volt, ULC Class A, Group 1. automatic ground fault circuit interrupting duplex receptacles with a 10 kA short circuit current rating automatic self-test diagnostics, green power on LED, and red ground fault LED. Ground fault receptacles for indoor climate controlled and outdoor or non-climate controlled areas are to be as follows:
 - .1 indoor climate controlled areas: equal to Hubbell Canada No. GFST15/GFST120 "AUTOGUARD"
 - .2 outdoor areas and indoor non-climate areas: equal to Hubbell Canada No.

2.6 SPECIFICATION GRADE TAMPER-RESISTANT DUPLEX RECEPTACLES

- .1 Specification Grade, back or side wired, U-ground, 2-pole, 3-wire tamper-resistant duplex receptacles as specified above, 15 ampere or 20 ampere, 125 volt as indicated on the drawings, each with thermoplastic shutters to limit access to energized contacts.

2.7 CLOCK HANGER RECEPTACLES

- .1 Equal to Legrand/Pass & Seymour #S3713W 15 ampere, 125 volt white recessed simplex receptacle with smooth white wall plate.

2.8 PHOTO ELECTRIC SWITCH

- .1 Equal to Tork 2100 Series weather-proof, 12 mm ($\frac{1}{2}$ ") dia. conduit mounting photoelectric SPST control switch with model number to suit the voltage and connected load, complete with an adjustable slide for on-off adjustment, a turn-on of one to five fc and a turn-off of three to five fc without the slide in position, a die-cast zinc gasketed enclosure, cadmium sulphide epoxy coated cell, normally closed contacts which fail in the open position, a delay of up to four minutes to prevent false switching due to light from vehicles, lightning, etc., three colour coded 150 mm (6") # 16 AWG leads, a fixed base for conduit connection, and, if required, an accessory bracket for wall mounting the device.

2.9 TIME SWITCH

- .1 Flush wall mounting spring wound ivory time switch with matching faceplate, equal to Tork A500 Series with exact catalogue number to suit the connected load.

2.10 DEVICE FACEPLATES

- .1 Device faceplates are to be ULC listed and CSA certified and, unless otherwise specified, supplied by the device manufacturer. Where two or more devices are installed in a common box, a common one-piece faceplate is to be used. Faceplate colours are specified in Part 3. Faceplates, unless otherwise specified, are to be as follows:
 - .1 "Decorator" type Phenolic switch and receptacle faceplates, white.

- .2 type 302 stainless steel switch and receptacle faceplates, brush finish or satin finish as directed, with stainless steel screws
- .3 high impact smooth finish switch and receptacle faceplates
- .4 hot dipped galvanized steel switch and receptacle faceplates
- .5 NEMA 3 rated, single gang, horizontal/vertical mounting, weather-proof in use, gasketed cast aluminium, receptacle faceplates to suit the type of receptacle used
- .6 weather-proof, gasketed, water-tight single gang type 302 stainless steel switch plate with clear silicone rubber bubble over the switch toggle

3 EXECUTION

3.1 GENERAL RE: INSTALLATION OF WIRING DEVICES

- .1 Provide all required wiring devices and faceplates
- .2 Confirm exact locations, including mounting heights prior to roughing-in.
- .3 For barrier-free mounting heights for devices, conform to requirements of the governing code or regulation.
- .4 Ensure that switches located adjacent to doors are located at the strike side of the door. Confirm door swings prior to roughing-in.
- .5 Install single throw switches with the handle in the up position when the switch is closed.
- .6 Confirm all switch, receptacle and faceplate types, colours and finishes prior to ordering
- .7 Provide a separate insulated ground conductor for each isolated ground receptacle.
- .8 Faceplates for computer equipment receptacles are to be permanently identified with "Computer Equipment Only" wording.
- .9 Faceplates for housekeeping receptacles are to be permanently identified with "Housekeeping Only" wording.
- .10 Do not install faceplates for flush devices until wall, etc., finishing work is complete
- .11 Where devices are to be installed in casework, millwork, or similar construction, carefully coordinate device installations and device openings with the trade providing the casework, millwork, etc.
- .12 Device locations indicated on the drawings are approximate, and, if requested, relocate the device up to 3 mm (10') away from the location shown at no additional cost.

3.2 WIRING DEVICE AND FACEPLATE TYPES AND COLOURS

- .1 Unless otherwise specified, wiring devices colours and faceplate types and colours are

to be as follows:

- .1 **switches & receptacles in finished areas-non-essential circuits:** white, stainless steel faceplates
- .2 **switches & receptacles in unfinished areas-non-essential circuits:** white, stainless steel faceplates
- .3 **switches & receptacles in finished areas-essential power circuits & isolated power switches:** red, with stainless steel faceplates
- .4 **isolated power receptacles:** cast aluminium gasketed weather-proof faceplates to suit the type of receptacle installed
- .5 **weather-proof switches:** weather-proof stainless steel faceplates with clear silicone bubble over the switch toggle

3.3 TESTING

- .1 When installation is complete, test operation of all devices.

END OF SECTION

- PART 1. GENERAL 1
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- 2.1 DISCONNECT SWITCHES 1
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- 3.1 INSTALLATION 1

PART 1. GENERAL

1.1 REFERENCES

CSA Group

- i. CAN/CSA-C22.2 No.4-04(R2009), Enclosed and Dead-Front Switches (Tri-National Standard, with ANCE NMX-J-162-2004 and UL 98).
- ii. CSA C22.2 No.39-13, Fuseholder Assemblies.

PART 2. PRODUCTS

2.1 DISCONNECT SWITCHES

- .1 Fusible and Non-fusible disconnect switch in CSA enclosure to CAN/CSA-C22.2 No.4 size as indicated.
- .2 Provision for padlocking in on-off switch position by locks.
- .3 Mechanically interlocked door to prevent opening when handle in ON position.
- .4 Fuses: size as indicated, in accordance with Section 26 28 13.01 - Fuses - Low Voltage.
- .5 Fuseholders: to CSA C22.2 No.39relocatable and suitable without adaptors, for type and size of fuse indicated.
- .6 Quick-make, quick-break action.
- .7 ON-OFF switch position indication on switch enclosure cover.

2.2 EQUIPMENT IDENTIFICATION

- .1 Provide equipment identification in accordance with Section 26 05 00 - Common Work Results for Electrical.
- .2 Indicate name of load controlled on size 4 nameplate.

PART 3. EXECUTION

3.1 INSTALLATION

- .1 Install disconnect switches complete with fuses if applicable.

END OF SECTION