



Addendum #2

Bid Opportunity: 7159-RW-22 - Smithson Public School - Office & HVAC Upgrades

Closing Date: Friday, March 25, 2022 2:00 PM

The following issued by the Board shall form part of the Bid / Proposal Solicitation document. The revisions and additions noted herein along with any attachments shall be read in conjunction with all other related documents. This Addendum shall, take precedence over the previously issued documents where differences occur. Receipt of this addendum must be acknowledged in the Bidding System, bids&tenders.

If you have already submitted a Bid / Proposal, it will be automatically withdrawn as a result of this addendum. You must resubmit the Bid / Proposal acknowledging all addenda and revising your Bid / Proposal to comply with all addenda.

ITEM 1

Last day for Questions is revised to: Wednesday, March 16th, 2022
2:00PM

Closing date is revised to: Friday, March 25th, 2022 2:00PM

ITEM 2

Refer to attached Electrical Specification (159 pages). Reissued for clarification since the original uploaded PDF was corrupted. No change in content.

ATTACHMENTS

Electrical Specification by BOLD engineering.

Tender Documents B20-349.02-A for
WRDSB – Smithson Public School
HVAC Upgrades and Interior Renovations
150 Belleview Avenue, Kitchener, Ontario

1.0 GENERAL

1.1 REFERENCES

- .1 Canadian Standards Association (CSA International)
 - .1 CSA C22.1 - 2012, Canadian Electrical Code, Part 1 (22nd Edition), Safety Standard for Electrical Installations.
 - .2 CSA C22.2. No. 0-10, General Requirements – Canadian Electrical Code Part II – Latest Edition.
 - .3 CAN/CSA-C22.3 No. 1-10, Overhead Systems – Latest Edition.
 - .4 CAN3-C235-83R2010, Preferred Voltage Levels for AC Systems, 0 to 50,000 V.
 - .5 C22.2 NO. 18.1-13 - Metallic outlet boxes

1.2 DESIGN REQUIREMENTS

- .1 Operating voltages: to CAN3-C235.
- .2 Motors, electric heating, control and distribution devices and equipment to operate satisfactorily at 60 Hz within normal operating limits established by above standard.
- .3 Equipment to operate in extreme operating conditions established in above standard without damage to equipment.
- .4 Language operating requirements: provide identification nameplates and labels for control items in English.

1.3 SUBMITTALS

- .1 Submittals: in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data: submit WHMIS MSDS in accordance with Section 01 47 15 - Sustainable Requirements: Construction and Section 02 61 33 - Hazardous Materials as applicable to this project.
- .3 Shop drawings:
 - .1 Submit drawings stamped and signed by professional engineer registered or licensed in Ontario, Canada.
 - .2 Submit 2 copies of shop drawing product data to Engineer for review.

- .3 If changes are required, notify Engineer of these changes before they are made.
 - .4 Shop drawings shall indicate clearly the materials and/or equipment actually being supplied, all details of construction, accurate dimensions, capacity, operating characteristics and performance. Each shop drawing shall give the identifying number of the specific piece of equipment etc. for which it was prepared (e.g. panel #2A).
 - .5 Each shop drawing for non-catalogue items shall be prepared specifically for this project. Shop drawings and brochures for catalogue items shall be marked clearly to show the items being supplied.
 - .6 Each shop drawing or catalogue sheet shall be stamped and signed by the contractor to indicate that he has checked the drawing for conformance with all requirements of the drawings and specifications, that he has coordinated this equipment with other equipment to which it is attached and/or connected thereto and that he has verified all dimensions to ensure the proper installation of equipment within the available space and without interference with the work of other trades. Ensure that mechanical co-ordination is complete before submitting drawings for review.
 - .7 Installation of any equipment shall not start until after final review of shop drawings has been obtained.
 - .8 When requested, shop drawings shall be supplemented by data explaining the theory of operation.
- .4 Quality Control: in accordance with Section 01 45 00 - Quality Control as applicable.
- .1 Provide CSA certified equipment and material.
 - .2 Where CSA certified equipment and material is not available, submit such equipment and material to ESA for special approval before delivery to site.
 - .3 Submit test results of installed electrical systems and instrumentation.
 - .4 Permits and fees: in accordance with General Conditions of contract.
 - .5 Submit, upon completion of Work, load balance report.
 - .6 Submit certificate of acceptance from authority having jurisdiction upon completion of Work to Engineer.

1.4 QUALITY ASSURANCE

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

- .2 Qualifications: electrical Work to be carried out by qualified, licensed electricians who hold valid Master Electrical Contractor license or apprentices in accordance with authorities having jurisdiction as per the conditions of the Provincial Act respecting manpower vocational training and qualification.
 - .1 Employees registered in provincial apprentices' program: permitted, under direct supervision of qualified licensed electrician, to perform specific tasks.
 - .2 Permitted activities: determined based on training level attained and demonstration of ability to perform specific duties.
- .3 Site Meetings:
 - .1 In accordance with Division 01 Requirements .
- .4 Health and Safety Requirements: do construction occupational health and safety in accordance with Section 01 35 30 - Health and Safety Requirements as applicable.

1.5 DELIVERY STORAGE AND HANDLING

- .1 Material Delivery Schedule: provide Departmental Representative and Engineer with schedule within 1 week after award of Contract.
- .2 Construction/Demolition Waste Management and Disposal: separate waste materials for reuse and recycling in accordance with Section 01 74 19 - Construction/Demolition Waste Management and Disposal as applicable.

1.6 SYSTEM STARTUP

- .1 Instruct Engineer and operating personnel in operation, care and maintenance of systems, system equipment and components.
- .2 Arrange and pay for services of manufacturer's factory service engineer to supervise start-up of installation, check, adjust, balance and calibrate components and instruct operating personnel.
- .3 Provide these services for such period, and for as many visits as necessary to put equipment in operation, and ensure that operating personnel are conversant with aspects of its care and operation.

1.7 CONSTRUCTION DRAWINGS

- .1 The drawings for the electrical work are performance drawings and diagrammatic, intended to convey the scope of the work and indicate general arrangement and approximate location of apparatus, fixtures and conduit runs. The drawings do not intend to show architectural



and structural details.

- .2 Do not scale drawings. Obtain information involving accurate dimensions shown on architectural and structural drawings, or by site measurements. Consult general construction drawings as well as detail drawings to become familiar with all conditions affecting work, and verify spaces in which the work will be installed.
- .3 Make, at no additional cost, any changes or additions to materials and/or equipment necessary to accommodate structural conditions (runs around beams, columns, etc.).
- .4 Alter, at no additional cost, the location of materials and/or equipment as directed, provided that the changes are made before installation and any such outlet is not relocated in excess of 10' in any direction.
- .5 Install all ceiling mounted components (luminaires, speakers, bells, etc.) in accordance with reflected ceiling drawings, approved by the Consultant.
- .6 Leave space clear and install all work to accommodate future materials and/or equipment as indicated, and to accommodate equipment and/or material supplied by another division of work or contract. Verify spaces in which work is to be installed. Install all conduit runs, etc., to maintain headroom and clearances and to conserve space in shafts and ceiling spaces.
- .7 Confirm on the site the exact location of outlets for equipment supplied under other divisions of work or contracts.
- .8 Confer with all trades installing equipment which may affect the work of this division, and arrange equipment in proper relation to equipment installed under all divisions of the contract.
- .9 Timeously furnish all items to be built in, complete with all pertinent information, commensurate with the progress of the work.
- .10 Store materials neatly and out of the way and clean up daily all refuse caused by the work.
- .11 Relocate equipment and/or material installed, but not coordinated with the work of other divisions, as directed by the Consultant at no extra cost.

1.8 EXISTING CONDITIONS

- .1 Visit the site and examine the existing conditions affecting the work of this Division.
- .2 No claim for extra payment shall be made for extra work made necessary by circumstances encountered due to conditions which were visible upon, or reasonably inferable from an examination of the site prior to submission of the Bid.

- .3 The Engineer will make periodic visits to the site during construction to ascertain reasonable conformity to plans and specifications. The Engineer is not responsible for quality control. The contractor shall maintain their own quality control and will be responsible for the execution of the Work in conformity with the Contract Documents and the requirements of the Authorities having Jurisdiction.
- .4 The Owner and Engineer shall have access to the site at all times for periodic inspections. The contractor shall maintain a complete set of contract documents on site for field reference by the Engineer.
- .3 The Contractor shall provide all gauges, instruments, and other equipment necessary for field review by the Engineer.
- .4 Application for final review will be considered when the Work has been completed and written declarations submitted that all commissioning, adjustment, set up and documentation is complete. Final review shall be completed when:
 - .1 All reported deficiencies have been corrected.
 - .2 All systems have been tested, commissioned and are operational.
 - .3 The Owner has been instructed in the operation and maintenance of all equipment.
 - .4 All reports have been submitted and reviewed.
 - .5 All instruction manuals have been submitted and reviewed.
 - .6 All directories and nameplates are in place.
 - .7 Cleaning up is finished in all respects.
 - .8 All spare parts and replacement parts specified have been provided.
 - .9 All record drawings have been submitted and reviewed.

1.9 GUARANTEE

- .1 The Contractor shall furnish a written guarantee, countersigned, stating that all work executed under this division will be free from defects of materials and workmanship for a period of two years from the date of final acceptance of this work. The above contractor further agrees that he will, at his own expense, repair, and replace all such defective work, and all other work damaged during the process of repair during the term of the warranty period, except where damage is due to negligence on the part of the Owner.
- .2 Furnish all extended guarantees for equipment requiring same in the specifications.

1.10 HOISTING AND MOVING

- .1 Carefully study the architectural and structural drawings with particular reference to the portions of the structure which are reinforced to withstand the forces applied during the transporting of heavy equipment across that structure.
- .2 Devise methods and schedules for the hoisting and transportation of equipment from grade to roof and then into the building, to ensure that no damage occurs to the structure, finish, or any other part of the building. Ensure that the schedule meets with the approval of the Construction Manager.

1.11 INTENT

- .1 Provide all items, articles, materials, operations and methods listed, mentioned and scheduled in the contract documents. Include all labour, equipment, tools, scaffolds and other incidentals necessary and required for the complete installation.
- .2 Consider the specifications as an integral part of the drawings which accompany them. Do not use the drawings or the specifications alone. Consider any item or subject omitted from one, mentioned or reasonably implied in the other, as properly and sufficiently specified and provide same under the work of this division.
- .3 Each Contractor is considered to be an expert in his field.

1.12 OPERATION AND MAINTENANCE MANUALS

- .1 Submit operation and maintenance manuals in accordance with Division 01.
- .2 Include the following information in the Operation and Maintenance manuals:
 - .1 Names and address of local suppliers for the items included.
 - .2 Engineering and operating manuals for installed equipment.
 - .3 Details of design elements, construction features, component function and maintenance requirements, to permit effective start-up, operation, maintenance, repair, modification, extension and expansion of any portion or feature of the installation. This includes, but is not limited to:
 - Digital photos of ductbanks showing conditions during installation.
 - Digital photos of properly labelled distribution panels with covers off.
 - Updated panel schedules.
 - Megger test results and transformer tap adjustment reports.
 - Detailed receipts for spare parts delivered to site, signed by WRDSB project coordinator as delivered in good order.

- .4 Technical data, product data, supplemented by bulletins, component illustrations, exploded views, technical descriptions of items and parts lists. Advertising or sales literature is not acceptable.
- .5 Review information provided in the maintenance instructions and manuals with the Owners' operating personnel to ensure a complete understanding of the electrical equipment and systems and their operation.

1.13 PERMITS, FEES AND INSPECTIONS

- .1 Submit to Electrical Inspection Department and Supply Authority necessary number of drawings and specifications for examination and approval prior to commencement of work.
- .2 Pay associated fees.
- .3 Engineer will provide drawings and specifications required by Electrical Inspection Department and Supply Authority at no cost. Drawings are to be submitted by the Electrical Contractor.
- .4 Notify Engineer of changes required by Electrical Inspection Department prior to making changes.
- .5 Furnish Certificates of Acceptance from Electrical Inspection Department authorities having jurisdiction on completion of work to Consultant.

1.14 RECORD DRAWINGS

- .1 The contractor shall clearly mark, as the job progresses, all changes and deviations from that shown on contract drawings. Drawings shall be kept up-to-date during construction and in addition to field measurements shall include variation orders, field instructions and all other changes.
- .2 On completion of the building, the contractor shall forward to the consultant the two sets of drawings indicating all such changes and deviations for review.

1.15 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate and recycle waste materials in accordance with Section 01 74 19 – Construction / Demolition Waste Management and Disposal.
- .2 Remove from site and dispose of all packaging materials at appropriate recycling facilities.
- .3 Collect and separate for disposal packaging material for recycling in accordance with Waste Management Plan.

- .4 Divert unused metal materials from landfill to metal recycling facility as approved by Consultant.
- .5 Fold up metal banding, flatten and place in designated area for recycling

2.0 PRODUCTS

2.1 ACCESS PANELS AND DOORS

- .1 Provide all access panels and/or doors to facilitate the maintenance and/or servicing of all electrical equipment installed in concealed spaces.
- .2 Indicate on the "as-built" drawings the location of these panels and doors.
- .3 Doors and panels in fire rated enclosures shall be ULC listed sandwich doors and shall have the same rating as the enclosure.
- .4 Doors shall have concealed hinges and screwdriver operated lock. Doors shall be as follows:
 - .1 Concrete Block and Drywall: 12 gauge prime painted steel door.
 - .2 Plaster and Acoustic Tile: recessed dish shaped door to accept ceiling tile or welded metal lath for plaster.
- .5 All access doors and locations shall be to the Consultant's approval.

2.2 CONDUIT IDENTIFICATION

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

<u>System</u>	<u>Prime</u>
up to 250 V	White
up to 600 V	Yellow
Telephone	Green
Other Communications	Green
Fire Alarm	Red
Emergency Voice	Orange
Other Security	TBC with WRDSB

2.3 EQUIPMENT IDENTIFICATION

- .1 Identify electrical equipment with nameplates and labels as follows:
 - .1 Nameplates: plastic limacodid 3 mm, black backing with white lettering mechanically attached with self tapping screws.
 - .2 Sizes as follows:

NAMEPLATE SIZES

Size 1	10 x 50 mm	1 line	3 mm high letters
Size 2	12 x 70 mm	1 line	5 mm high letters
Size 3	12 x 70 mm	2 lines	3 mm high letters
Size 4	20 x 90 mm	1 line	8 mm high letters
Size 5	20 x 90 mm	2 lines	5 mm high letters
Size 6	25 x 100 mm	1 line	12 mm high letters
Size 7	25 x 100 mm	2 lines	6 mm high letters

- .2 Labels: embossed plastic labels with 6 mm high letters unless specified otherwise.
- .3 Wording on nameplates and labels to be approved by Departmental Representative and Engineer prior to manufacture.
- .4 Allow for minimum of twenty-five (25) letters per nameplate and label.
- .5 Nameplates for terminal cabinets and junction boxes to indicate system and/or voltage characteristics.
- .6 Disconnects, starters and contactors: indicate equipment being controlled and voltage.
- .7 Terminal cabinets and pull boxes: indicate system and voltage.
- .8 Transformers: indicate capacity, primary and secondary voltages.

2.4 FINISHES

- .1 Shop finish metal enclosure surfaces by application of rust resistant primer inside and outside, and at least two coats of finish enamel.
- .2 Clean and touch up surfaces of shop-painted equipment scratched or marred during shipment or installation, to match original paint.
- .3 Clean and prime exposed non-galvanized hangers, racks and fastenings to prevent rusting.

2.5 MATERIALS AND EQUIPMENT

- .1 Provide materials and equipment in accordance with Division 01.
- .2 Equipment and material to be CSA certified. Where there is no alternative to supplying equipment, which is not CSA certified, obtain special approval from Electrical Inspection Department.
- .3 Factory assemble control panels and component assemblies.

2.6 VIBRATION ISOLATION

- .1 Provide vibration isolation control as necessary so as to prevent transmission of objectionable vibration to the building structure, and from one area to another.
- .2 Provide all steel bases and concrete inertia pads. Install all bases to clear the sub-base (housekeeping pads) by minimum 1" (25mm) for steel bases, and 2" (50mm) for concrete bases.
- .3 All floor mounted equipment shall be erected on 4" (102mm) high reinforced concrete pads. Concrete pads shall be of similar dimensions to that of the foot print of the equipment. Wherever vibration eliminating devices and/or concrete inertia blocks are specified, these items shall, in all cases, be mounted upon the 4" (102mm) high reinforced concrete pads; unless specified to the contrary.
- .4 All concrete foundations and supports shall be provided by this division. This contractor shall provide dimensioned drawings and details of all such work required and shall submit same to the Consultant for approval.

2.7 WARNING SIGNS

- .1 As specified and to meet requirements of Electrical Inspection Department, Local Authority and Consultant.
- .2 Decal signs, minimum size 8" x 10" (175mm x 250mm).

2.8 WIRING TERMINATIONS

- .1 Lugs, terminals, screws used for termination of wiring to be suitable for either copper or aluminum conductors.

2.9 WIRING IDENTIFICATION

- .1 Identify wiring with permanent indelible identifying markings, numbered, coloured plastic tapes, on both ends of phase conductors of feeders and branch circuit wiring.
- .2 Maintain phase sequence and colour coding throughout.

- .3 Colour coding: to CSA C22.1.
- .4 Use colour coded wires in communication cables, matched throughout system.

3.0 EXECUTION

3.1 CLEANING

- .1 Clean and touch up surfaces of shop-painted equipment scratched or marred during shipment or installation, to match original paint.
- .2 Clean and prime exposed non-galvanized hangers, racks and fastenings to prevent rusting.
- .3 Clean all fixtures and equipment. Polish all plated surfaces.
- .4 Set all relays to operating condition.
- .5 Remove all temporary protection and covers.
- .6 Vacuum clean the inside of switchgear, panel boards, motor control centre, and fire alarm control panel and annunciators. Ensure that they are free from debris and dust.
- .7 Change all lamps, all lamps to be new at time of system acceptance.
- .8 Leave electrical work in new working order.

3.2 CONDUIT AND CABLE INSTALLATION

- .1 Install conduit and sleeves prior to pouring of concrete.
 - .1 Sleeves through concrete: plastic, sized for free passage of conduit, and protruding 2” (50mm).
- .2 If plastic sleeves are used in fire rated walls or floors, remove before conduit installation.
- .3 Install cables, conduits and fittings to be embedded or plastered over, neatly and close to building structure so furring can be kept to minimum.

3.3 CUTTING AND PATCHING

- .1 Perform all cutting and patching required for the installation of new equipment and surface restoration after the removal of existing equipment. Work will be carried out by others at this Contractor’s cost. For patching use materials equal to those comprising the surrounding area.

- .2 Inform other Division Contractors in sufficient time with regard to required openings. Where this requirement is not met, bear the cost of all cutting and patching.
- .3 In existing work, and work already finished, cutting and patching will be carried out by the General Contractor at the Electrical Contractors' expense.
- .4 Be aware of fire rated partitions, minimize the area affected by the work, and return all surfaces to a condition encountered before the work. Acceptance of the finished work is at the sole discretion of the Consultant.
- .5 Painting of finished surfaces will be by the General Contractor to match adjacent surfaces.

3.4 DEMOLITION

- .1 Make safe and disconnect all power and systems, as and when, and to the extent required to facilitate with the demolition.
- .2 Ensure that all electrical, life safety services, and services for existing equipment, in areas outside the areas of this work, that are required to remain in service, shall do so.
- .3 Relocate any electrical feeders or equipment that are required to remain in service, that are secured to existing walls, floors or ceilings to be demolished or that are buried and required to be excavated for new work.
- .4 Remove and replace any electrical equipment on walls or ceilings that will be demolished and rebuilt.
- .5 When deleting and/or making safe existing electrical work, ensure that it includes all wiring back to the associated panelboard or control panel.
- .6 Disconnect and remove existing light fixtures, devices, outlets, etc. which are not to be reused. Such items shall be cartoned and turned over to the Owner at a place designated by the Owner. Cut back and cap unused raceway and outlets and remove unused wiring back to panelboard in an approved manner.
- .7 Ensure that all existing equipment which is to be reused and/or relocated is thoroughly inspected and refurbished to ensure correct operation when put back into service and to meet Ontario Hydro approval.
- .8 All existing electrical equipment which is no longer required shall be removed and disposed of, off site. Removed equipment shall be detailed and listed for WRDSB review and to exercise "First right of refusal" for turnover of equipment to School Board.
- .9 Be responsible and pay for any damage to the base building incurred by work of this Division, or repair to the satisfaction of the Consultant.

- .10 Carry out the work with a minimum of noise, dust and disturbance.
- .11 Provide tools and clean up equipment. Obtain the Owner's permission for the use of electrical, plumbing or drainage outlets.
- .12 Provide daily clean-up and proper disposal of debris generated by daily operations. On completion of the work, all tools, surplus materials and waste materials shall be removed and the premises left in a clean, perfect condition.

3.5 EXPANSION JOINTS AND LOOPS

- .1 Supply and install expansion joints or loops in conduits crossing expansion joints in the structure without imposing undue stress on structure, apparatus or conduit.

3.6 FIELD QUALITY CONTROL

- .1 Load Balance:
 - .1 Measure phase current to panelboards with normal loads (lighting) operating at time of acceptance; adjust branch circuit connections as required to obtain best balance of current between phases and record changes.
 - .2 Measure phase voltages at loads and adjust transformer taps to within 2% of rated voltage of equipment.
 - .3 Provide upon completion of work, load balance report as directed in PART 1 - Submittals: phase and neutral currents on panelboards, dry-core transformers and motor control centres, operating under normal load, as well as hour and date on which each load was measured, and voltage at time of test.
- .2 Conduct following tests in accordance with Section 01 45 00 - Quality Control as applicable:
 - .1 Power distribution system including phasing, voltage, grounding and load balancing.
 - .2 Circuits originating from branch distribution panels.
 - .3 Lighting and its control.
 - .4 Motors, heaters and associated control equipment including sequenced operation of systems where applicable.
 - .5 Systems: fire alarm system, communications as applicable.
 - .6 Insulation resistance testing:
 - .1 Megger circuits, feeders and equipment up to 350 V with a 500 V instrument.

- .2 Megger 350-600 V circuits, feeders and equipment with a 1000 V instrument.
- .3 Check resistance to ground before energizing.
- .3 Carry out tests in presence of Engineer when requested.
- .4 Provide instruments, meters, equipment and personnel required to conduct tests during and at conclusion of project.
- .5 Submit test results to Engineer for review.

3.7 FIRE STOPPING

- .1 Where cable, bus ducts, cable tray or conduits pass through floors and fire rated walls, provide fire stopping and smoke seal in accordance with Division 01.

3.8 LOCATION OF OUTLETS

- .1 Locate outlets in accordance with Section 26 05 32 - Outlet Boxes, Conduit Boxes and Fittings and contract drawings.
- .2 Do not install outlets back-to-back in wall; allow minimum 6" (150 mm) horizontal clearance between boxes.
- .3 Change location of outlets at no extra cost or credit, providing distance does not exceed 10' (3000 mm), and information is given before installation.
- .4 Locate light switches on latch side of doors unless shown otherwise.

3.9 MOUNTING HEIGHTS

- .1 Mounting height of equipment is from finished floor to centreline of equipment unless specified or indicated otherwise.
- .2 If mounting height of equipment is not specified or indicated, verify before proceeding with installation.
- .3 Install electrical equipment at following heights unless indicated otherwise.
 - .1 Local switches: 44" (1100 mm).
 - .2 Wall receptacles:
 - .1 General: 18" (450 mm).

- .2 Above top of continuous baseboard heater: 8” (200 mm).
- .3 Above top of counters or counter splash backs: 6” (150 mm).
- .3 Panelboards: as required by Code or as indicated.
- .4 Telephone and interphone outlets: 18” (450mm).
- .4 Contractor shall verify mounting heights with latest applicable CSA requirements and report any discrepancies with Engineer prior to installation.

3.10 PROTECTION

- .1 Protect building and structure from damage due to carrying out this work.
- .2 Protect all electrical work from damage. Keep all equipment dry and clean at all times.
- .3 Cover all opening in equipment and materials.
- .4 Be responsible for and make good any damage caused directly or indirectly to any walls, floors, ceilings, woodwork, brickwork, finishes, etc.

3.11 TEMPORARY SERVICES

- .1 Temporary electrical services shall be provided by others, unless otherwise noted. Coordinate with General Contractor for further detail.
- .2 Do not use any of the permanent electrical systems during construction, unless specific written approval is obtained from the Consultant or unless allowed elsewhere in the contract documents.
- .3 The use of permanent facilities for temporary construction service shall not affect in any way the commencement period in which correction after completion is the Contractor's responsibility. Such period will commence only when the overall project is completed and certificates are issued.

3.12 WORKMANSHIP

- .1 Install conduits and pipes parallel and perpendicular to the building planes and concealed in chases, behind furring or above ceiling, except in unfinished areas. Install all exposed systems neatly and grouped together, to present a neat appearance.
- .2 Install meters and switches to permit easy reading.



- .3 Install all equipment and apparatus requiring maintenance, adjustment or replacement with sufficient clearance for servicing.
- .4 Install control devices to guarantee proper sensing. Shield element from direct radiation and avoid placing them behind any obstruction.
- .5 Include in the work all requirements of the manufacturer and as shown on the shop drawings.
- .6 Replace any work unsatisfactory to the Consultant/owner without extra cost.

END OF SECTION

1.0 GENERAL

1.1 SUMMARY

- .1 Canadian Standards Association (CSA International)
 - .1 This Section includes requirements for selective demolition and removal of electrical safety and security components including removal of conduit, junction boxes, and panels to source and incidentals required to complete work described in this Section ready for new construction.

1.2 REFERENCES

- .1 Canadian Standards Association (CSA)
 - .1 CSA S350 M1980, Code of Practice for Safety in Demolition of Structures.

1.3 DEFINITIONS

- .1 Demolish: Detach items from existing construction and legally dispose of items off site, unless indicated as removed and salvaged, or removed and reinstalled.
- .2 Remove: Planned deconstruction and disassembly of electrical items from existing construction including removal of conduit, junction boxes, cabling and wiring from electrical component to panel taking care not to damage adjacent assemblies designated to remain; legally dispose of items off site, unless indicated as removed and salvaged, or removed and reinstalled.
- .3 Remove and Salvage: Detach items from existing construction and deliver them to Owner ready for reuse.
- .4 Remove and Reinstall: Detach items from existing construction, prepare them for reuse, and reinstall them where indicated.
- .5 Existing to Remain: Existing items of construction that are not removed and that are not otherwise indicated as being removed and salvaged, or removed and reinstalled.
- .6 Hazardous Substances: Dangerous substances, dangerous goods, hazardous commodities and hazardous products may include asbestos, mercury and lead, PCB's, poisons, corrosive agents, flammable substances, radioactive substances, or other material that can endanger human health or wellbeing or environment if handled improperly as defined by Federal Hazardous Products Act including latest amendments.

1.4 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Action Submittals: Provide in accordance with Section 01 33 00– Submittal Procedures before starting work of this Section:
 - .1 Construction Waste Management Plan: Submit plan addressing opportunities for reduction, reuse, or recycling of materials prepared in accordance with Construction Waste Management and Disposal.
 - .2 Landfill Records: Indicate receipt and acceptance of selective demolition waste and hazardous wastes by a landfill facility licensed to accept hazardous wastes.

1.5 ADMINISTRATIVE REQUIREMENTS

- .1 Coordination: Coordinate work of this Section to avoid interference with work by other Sections.
- .2 Scheduling: Account for Owner’s continued occupancy requirements during selective demolition and schedule staged occupancy and worksite activities as a defined item in accordance.

1.6 QUALITY ASSURANCE

- .1 Regulatory Requirements: Perform work of this Section in accordance with:
 - .1 Provincial/Territorial Workers’ Compensation Boards/Commissions.

1.7 SITE CONDITIONS

- .1 Existing Conditions: Condition of materials identified as being salvaged or demolished are based on their observed condition at time of site examination before tendering.
- .2 Existing Hazardous Substances: Owner performed a hazardous substances assessment and it is not expected that hazardous substances will be encountered in Work.
 - .1 Hazardous substances will be removed by a hazardous abatement specialist engaged by Owner before start of Work.
- .3 Existing Hazardous Substances: Owner has performed a hazardous substances assessment and identified materials requiring abatement as follows:
 - .1 Hazardous substances are as defined in Hazardous Products Act.
- .4 Discovery of Hazardous Substances: It is not expected that Hazardous Substances will be encountered in Work; immediately notify Consultant if materials suspected of containing hazardous substances are encountered and perform following activities:
 - .1 Hazardous substances will be as defined in Hazardous Products Act.

- .2 Stop work in area of suspected hazardous substances.
- .3 Take preventative measures to limit users' and workers' exposure, provide barriers and other safety devices and do not disturb.
- .4 Hazardous substances will be removed by Owner under a separate contract or as a change to Work.
- .5 Proceed only after written instructions have been received from Owner.

1.8 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate and recycle waste materials in accordance with Section 01 74 19 – Construction / Demolition Waste Management and Disposal.
- .2 Remove from site and dispose of all packaging materials at appropriate recycling facilities.
- .3 Collect and separate for disposal packaging material for recycling in accordance with Waste Management Plan.
- .4 Divert unused metal materials from landfill to metal recycling facility as approved by Consultant.
- .5 Fold up metal banding, flatten and place in designated area for recycling.

2.0 PRODUCTS

2.1 NOT USED REPAIR MATERIALS

- .1 N/A

3.0 EXECUTION

3.1 EXAMINATION

- .1 Verification of Existing Conditions: Visit site, thoroughly examine and become familiar with conditions that may affect work of this Section before tendering Bid; Owner will not consider claims for extras for work or materials necessary for proper execution and completion of contract that could have been determined by a site visit.

3.2 PREPARATION

- .1 Protection of Existing Systems to Remain: Protect systems and components indicated to remain in place during selective demolition operations and as follows:

- .1 Prevent movement and install bracing to prevent settlement or damage of adjacent services and parts of existing buildings scheduled to remain.
- .2 Notify Consultant and cease operations where safety of buildings being demolished, adjacent structures or services appears to be endangered and await additional instructions before resuming demolition work specified in this Section.
- .3 Prevent debris from blocking drainage inlets.
- .4 Protect mechanical systems that will remain in operation.
- .2 Protection of Building Occupants: Sequence demolition work so that interference with use of the building by Owner and users is minimized and as follows:
 - .1 Prevent debris from endangering safe access to and egress from occupied buildings.
 - .2 Notify Consultant and cease operations where safety of occupants appears to be endangered and await additional instructions before resuming demolition work specified in this Section.

3.3 EXECUTION

- .1 Removal: Coordinate requirements of this Section with information contained in and as follows:
 - .1 Disconnect electrical circuits and panel feeders; maintain electrical service and main distribution panel as is, ready for subsequent Work.
 - .2 Disconnect and remove existing fire alarm system including associated conduits, boxes, wiring, and similar items unless specifically noted otherwise.
 - .3 Perform demolition work in a neat and workmanlike manner:
 - .1 Remove tools or equipment after completion of work, and leave site clean and ready for subsequent renovation work.
 - .2 Repair and restore damages caused as a result of work of this Section to match existing materials and finishes.
 - .4 Seal open ends of conduit with silicone sealant and leave in place where they are inaccessible or cannot be removed without damaging adjacent construction.

3.4 CLOSEOUT ACTIVITIES



- .1 Demolition Waste Disposal: Arrange for legal disposal and remove demolished materials to accredited provincial landfill site or alternative disposal site (recycle centre).

END OF SECTION

1.0 GENERAL

1.1 REFERENCES

- .1 Canadian Standards Association (CSA)
 - .1 CSA C22.2 No .0.3, Test Methods for Electrical Wires and Cables.
 - .2 CAN/CSA-C22.2 No. 131, Type TECK 90 Cable.

1.2 PRODUCT DATA

- .1 Submit product data in accordance with Section 01300 - Submittal Procedures.

1.3 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate and recycle waste materials in accordance with Section 01 74 19 – Construction / Demolition Waste Management and Disposal.
- .2 Remove from site and dispose of all packaging materials at appropriate recycling facilities.
- .3 Collect and separate for disposal packaging material for recycling in accordance with Waste Management Plan.
- .4 Divert unused metal materials from landfill to metal recycling facility as approved by Consultant.
- .5 Fold up metal banding, flatten and place in designated area for recycling.

2.0 PRODUCTS

2.1 BUILDING WIRES

- .1 Conductors: stranded for 10 AWG and larger. Minimum size: 12 AWG.
- .2 Copper conductors: size as indicated, with 1000 V insulation of chemically cross-linked thermosetting polyethylene material rated RW90.

2.2 TECK CABLE

- .1 Cable: to CAN/CSA-C22.2 No. 131.
- .2 Conductors:
 - .1 Grounding conductor: copper.

- .2 Circuit conductors: copper, size as indicated.
- .3 Insulation:
 - .1 Type: ethylene propylene rubber.
 - .2 Chemically cross-linked thermosetting polyethylene rated type RW90, 600 V.
- .4 Inner jacket: polyvinyl chloride material.
- .5 Armour: interlocking galvanized steel.
- .6 Overall covering: thermoplastic polyvinyl chloride material.
- .7 Fastenings:
 - .1 One hole steel straps to secure surface cables 50 mm and smaller. Two hole steel straps for cables larger than 50 mm.
 - .2 Channel type supports for two or more cables at 1500 mm centers.
 - .3 Threaded rods: 6 mm dia. to support suspended channels.
- .8 Connectors:
 - .1 Watertight approved for TECK cable.

2.3. ARMoured CABLES

- .1 Conductors: insulated, copper, size as indicated.
- .2 Type: AC90.
- .3 Armour: interlocking type fabricated from aluminum strip.
- .4 Type: ACWU90 flame retardant jacket over armour meeting requirements of Vertical Tray Fire Test of CSA C22.2 No. 0.3 with maximum flame travel of 1.2 m.
- .5 Connectors: standard as required.

2.4. ALUMINUM SHEATHED CABLE

- .1 Conductors: copper, size as indicated.
- .2 Insulation: type RA90 rated 600 V.
- .3 Sheath: aluminum applied to form continuous corrugated sheath.

- .4 Outer jacket of PVC applied over sheath for direct burial or wet locations.
- .5 Fastenings for aluminum sheathed cable:
 - .1 One hole steel straps to secure surface cables 25 mm and smaller. Two-hole steel straps for cables larger than 25 mm. Use aluminum strap only with single conductor cable.
 - .2 Channel type supports for two or more cables at 1500 mm centers.
 - .3 Threaded rods: 6 mm dia. to support suspended channels.

2.5. CONTROL CABLES

- .1 Type LVT: 2 soft annealed copper conductors, sized as indicated, with thermoplastic insulation, outer covering of thermoplastic jacket.
- .2 Low energy 300 V control cable: stranded annealed copper conductors sized as indicated, with PVC insulation type TW -40°C polyethylene insulation with shielding of tape coated with paramagnetic material wire braid over each conductor and overall covering of PVC jackets.

3.0 EXECUTION

3.1. INSTALLATION OF BUILDING WIRES

- .1 Install wiring as follows:
 - .1 In conduit systems in accordance with Section 26 05 34.
 - .2 In cabletroughs in accordance with Section 26 05 33.
 - .3 In underground ducts in accordance with Section 26 05 43.
 - .4 In trenches in accordance with Section 26 05 43.
 - .5 In underfloor distribution system in accordance with Section 26 05 39.
 - .6 In cellular floor raceways in accordance with Section 26 05 38.
 - .7 In surface and lighting fixture raceways in accordance with Section 26 50 00.
 - .8 In wireways and auxiliary gutters in accordance with Section 26 05 37.
 - .9 Overhead service conductors in accordance with Section 26 24 01.

3.2. INSTALLATION OF TECK CABLE 0 -1000 V

- .1 Install cables.
 - .1 Group cables wherever possible on channels.
- .2 Installation of Teck cable to be avoided where possible to complete installations in EMT conduit.
- .3 Install cable in trenches in accordance with Section 26 05 43.
- .4 Lay cable in cabletroughs in accordance with Section 26 05 33.
- .5 Terminate cables in accordance with Section 26 05 20 - Wire and Box Connectors - 0 - 1000V.

3.3. INSTALLATION OF ARMOURED CABLES

- .1 Group cables wherever possible.
- .2 Use to be limited to final drops to devices/fixtures within 3.0m limit.
- .3 Install cable in trenches in accordance with Section 26 05 43.
- .4 Lay cable in cable troughs in accordance with Section 26 05 33.
- .5 Terminate cables in accordance with Section 26 05 20 - Wire and Box Connectors - 0 - 1000V.

3.4. INSTALLATION OF ALUMINUM SHEATHED CABLES

- .1 Group cables wherever possible on channels.
- .2 Installation of aluminum sheathed cable to be avoided where possible to complete installations in EMT conduit.
- .3 Install cable in trenches in accordance with Section 26 05 43.
- .4 Lay cable in cable troughs in accordance with Section 26 05 33.
- .5 Terminate cables in accordance with Section 26 05 20 - Wire and Box Connectors - 0 - 1000V.

3.5. INSTALLATION OF CONTROL CABLES

- .1 Install control cables in conduit, under floor raceways, cable troughs and underground ducts by direct burial as indicated.



- .2 Ground control cable shield.

3.6. INSTALLATION OF NON-METALLIC SHEATHED CABLE

- .1 Install cables.
- .2 Install straps and box connectors to cables as required.

END OF SECTION

1.0 GENERAL

1.1 REFERENCES

- .1 Canadian Standards Association (CSA)
 - .1 CSA C22.2 No .0.3, Test Methods for Electrical Wires and Cables.
 - .2 CAN/CSA-C22.2 No. 131, Type TECK 90 Cable.

1.2 PRODUCT DATA

- .1 Submit product data in accordance with Section 01300 - Submittal Procedures.

1.3 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate and recycle waste materials in accordance with Section 01 74 19 – Construction / Demolition Waste Management and Disposal.
- .2 Remove from site and dispose of all packaging materials at appropriate recycling facilities.
- .3 Collect and separate for disposal packaging material for recycling in accordance with Waste Management Plan.
- .4 Divert unused metal materials from landfill to metal recycling facility as approved by Consultant.
- .5 Fold up metal banding, flatten and place in designated area for recycling.

2.0 PRODUCTS

2.1 BUILDING WIRES

- .1 Conductors: stranded for 10 AWG and larger. Minimum size: 12 AWG.
- .2 Copper conductors: size as indicated, with 1000 V insulation of chemically cross-linked thermosetting polyethylene material rated RW90.

2.2 TECK CABLE

- .1 Cable: to CAN/CSA-C22.2 No. 131.
- .2 Conductors:
 - .1 Grounding conductor: copper.

- .2 Circuit conductors: copper, size as indicated.
- .3 Insulation:
 - .1 Type: ethylene propylene rubber.
 - .2 Chemically cross-linked thermosetting polyethylene rated type RW90, 600 V.
- .4 Inner jacket: polyvinyl chloride material.
- .5 Armour: interlocking galvanized steel.
- .6 Overall covering: thermoplastic polyvinyl chloride material.
- .7 Fastenings:
 - .1 One hole steel straps to secure surface cables 50 mm and smaller. Two hole steel straps for cables larger than 50 mm.
 - .2 Channel type supports for two or more cables at 1500 mm centers.
 - .3 Threaded rods: 6 mm dia. to support suspended channels.
- .8 Connectors:
 - .1 Watertight approved for TECK cable.

2.3. MINERAL-INSULATED CABLES

- .1 Conductors: solid bare soft-annealed copper, size as indicated.
- .2 Insulation: compressed powdered magnesium oxide to form compact homogeneous mass throughout entire length of cable.
- .3 Overall covering: annealed seamless copper sheath, Type M1 rated 600 V, 250°C.
- .4 Overall covering: annealed seamless copper sheath type LWM1 rated 600 V, 250°C.
- .5 Outer jacket: PVC applied over sheath.
- .6 Two-hour fire rating.
- .7 Connectors: standard as required.
- .8 Termination kits: standard as required.

2.4. ARMOURED CABLES

- .1 Conductors: insulated, copper, size as indicated.
- .2 Type: AC90.
- .3 Armour: interlocking type fabricated from aluminum strip.
- .4 Type: ACWU90 flame retardant jacket over armour meeting requirements of Vertical Tray Fire Test of CSA C22.2 No. 0.3 with maximum flame travel of 1.2 m.
- .5 Connectors: standard as required.

2.5. ALUMINUM SHEATHED CABLE

- .1 Conductors: copper, size as indicated.
- .2 Insulation: typeRA90 rated 600 V.
- .3 Sheath: aluminum applied to form continuous corrugated sheath.
- .4 Outer jacket of PVC applied over sheath for direct burial or wet locations.
- .5 Fastenings for aluminum sheathed cable:
 - .1 One hole steel straps to secure surface cables 25 mm and smaller. Two-hole steel straps for cables larger than 25 mm. Use aluminum strap only with single conductor cable.
 - .2 Channel type supports for two or more cables at 1500 mm centers.
 - .3 Threaded rods: 6 mm dia. to support suspended channels.

2.6. CONTROL CABLES

- .1 Type LVT: 2 soft annealed copper conductors, sized as indicated, with thermoplastic insulation, outer covering of thermoplastic jacket.
- .2 Low energy 300 V control cable: stranded annealed copper conductors sized as indicated, with PVC insulation type TW -40°C polyethylene insulation with shielding of tape coated with paramagnetic material wire braid over each conductor and overall covering of PVC jackets.

2.7. NON-METALLIC SHEATHED CABLE

- .1 Non-metallic sheathed copper] cable type: NMD-7 nylon, size as indicated.

3.0 EXECUTION

3.1. INSTALLATION OF BUILDING WIRES

- .1 Install wiring as follows:
 - .1 In conduit systems in accordance with Section 26 05 34.
 - .2 In cabletroughs in accordance with Section 26 05 33.
 - .3 In underground ducts in accordance with Section 26 05 43.
 - .4 In trenches in accordance with Section 26 05 43.
 - .5 In underfloor distribution system in accordance with Section 26 05 39.
 - .6 In cellular floor raceways in accordance with Section 26 05 38.
 - .7 In surface and lighting fixture raceways in accordance with Section 26 50 00.
 - .8 In wireways and auxiliary gutters in accordance with Section 26 05 37.
 - .9 Overhead service conductors in accordance with Section 26 24 01.

3.2. INSTALLATION OF TECK CABLE 0 -1000 V

- .1 Install cables.
 - .1 Group cables wherever possible on channels.
- .2 Install cable in trenches in accordance with Section 26 05 43.
- .3 Lay cable in cabletroughs in accordance with Section 26 05 33.
- .4 Terminate cables in accordance with Section 26 05 20 - Wire and Box Connectors - 0 - 1000V.

3.3. INSTALLATION OF MINERAL-INSULATED CABLES

- .1 Install cable in trenches in accordance with Section 26 05 43.
- .2 Run cable exposed, securely supported by straps.
- .3 Support 2 h fire rated cables at 1m intervals.
- .4 Make cable terminations by using factory-made kits.
- .5 At cable terminations use thermoplastic sleeving over bare conductors.

- .6 Install cable in cable troughs in accordance with Section 26 05 33.
- .7 Where cables are buried in cast concrete or masonry, sleeve for entry and exit of cables.
- .8 Do not splice cables.

3.4. INSTALLATION OF ARMOURED CABLES

- .1 Group cables wherever possible.
- .2 Install cable in trenches in accordance with Section 26 05 43.
- .3 Lay cable in cable troughs in accordance with Section 26 05 33.
- .4 Terminate cables in accordance with Section 26 05 20 - Wire and Box Connectors - 0 - 1000V.

3.5. INSTALLATION OF ALUMINUM SHEATHED CABLE

- .1 Group cables wherever possible on channels.
 - .1 Install cable in trenches in accordance with Section 26 05 43.
- .2 Lay cable in cabletroughs in accordance with Section 26 05 33.
- .3 Terminate cables in accordance with Section 26 05 20 - Wire and Box Connectors – 0 -1000V.

3.6. INSTALLATION OF CONTROL CABLES

- .1 Install control cables in conduit, under floor raceways, cable troughs and underground ducts by direct burial as indicated.
- .2 Ground control cable shield.

3.7. INSTALLATION OF NON-METALLIC SHEATHED CABLE

- .1 Install cables.
- .2 Install straps and box connectors to cables as required.

END OF SECTION

1.0 GENERAL

1.1 SECTION INCLUDES

- .1 Materials and installation for connectors and terminations.

1.2 REFERENCES

- .1 Canadian Standards Association (CSA)
 - .1 CSA C22.2 No.41, Grounding and Bonding Equipment.

1.3 PRODUCT DATA

- .1 Obtain inspection certificate of compliance covering high voltage stress coning from inspection authority (ESA) and include it with as-built drawings, and close out documents.

1.4 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate and recycle waste materials in accordance with Section 01 74 19 – Construction / Demolition Waste Management and Disposal.
- .2 Remove from site and dispose of all packaging materials at appropriate recycling facilities.
- .3 Collect and separate for disposal packaging material for recycling in accordance with Waste Management Plan.
- .4 Divert unused metal materials from landfill to metal recycling facility as approved by Consultant.
- .5 Fold up metal banding, flatten and place in designated area for recycling.

2.0 PRODUCTS

2.1 CONNECTORS AND TERMINATIONS

- .1 Copper, long barrel compression connectors to CSA C22.2 No. 65-95 as required sized for conductors.
- .2 2-4 way joint boxes (as required), damp location type, in accordance with Section 26 05 33 - Raceway and Boxes for Electrical Systems.
- .3 2-4 way junction boxes (as required) with respective pothead for 2-4 conductor cables (as required), for enclosing stress - cone within in accordance with Section 26 05 33 - Raceway and Boxes for Electrical Systems.



3.0 EXECUTION

3.1. INSTALLATION

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

END OF SECTION

1.0 GENERAL

1.1 REFERENCES

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

1.2 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for grounding equipment and include product characteristics, performance criteria, physical size, finish and limitations.

1.3 CLOSEOUT SUBMITTALS

- .1 Submit in accordance with Section 01 78 00 - Closeout Submittals.
- .2 Operation and Maintenance Data: submit operation and maintenance data for grounding equipment for incorporation into manual.

1.4 DELIVERY, STORAGE AND HANDLING

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

1.5 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate and recycle waste materials in accordance with Section 01 74 19 – Construction / Demolition Waste Management and Disposal.
- .2 Remove from site and dispose of all packaging materials at appropriate recycling facilities.
- .3 Collect and separate for disposal packaging material for recycling in accordance with Waste Management Plan.

- .4 Divert unused metal materials from landfill to metal recycling facility as approved by Consultant.
- .5 Fold up metal banding, flatten and place in designated area for recycling.

2.0 PRODUCTS

2.1 EQUIPMENT

- .1 Clamps for grounding of conductor: size as required to electrically conductive underground water pipe.
- .2 Grounding conductors: bare stranded copper, soft annealed, size as indicated.
- .3 Insulated grounding conductors: green, copper conductors, size as indicated, type RWU.
- .4 Ground bus: copper, size as indicated, complete with insulated supports, fastenings, connectors.
- .5 Non-corroding accessories necessary for grounding system, type, size, material as indicated, including but not necessarily limited to:
 - .1 Grounding and bonding bushings.
 - .2 Bolted type conductor connectors.
 - .3 Thermit welded type conductor connectors.
 - .4 Bonding jumpers, straps.
 - .5 Pressure wire connectors.

3.0 EXECUTION

3.1 EXAMINATION

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

3.2 INSTALLATION GENERAL

- .1 Install complete permanent, continuous grounding and bonding system including all conductors, connectors, accessories needed to provide a complete and approved system.
- .2 Where rigid PVC is used, run ground wire in conduit.

- .3 Where EMT is used, run ground wire in conduit.
- .4 Provide and install grounding for bollards as per local utility requirements where applicable.
- .5 Install connectors in accordance with manufacturer's instructions.
- .6 Protect exposed grounding conductors from mechanical injury.
- .7 Use mechanical connectors for grounding connections to equipment provided with lugs.
- .8 Soldered joints not permitted.
- .9 Install bonding wire for flexible conduit, connected at one end to grounding bushing, solderless lug, clamp or cup washer and screw. Neatly cleat bonding wire to exterior of flexible conduit.
- .10 Make grounding connections in radial configuration only, with connections terminating at single grounding point. Avoid loop connections.

3.3 SYSTEM AND CIRCUIT GROUNDING

- .1 Install system grounding and circuit bonding connections to neutral of secondary 600/347V, and the 120/208V systems.

3.4 EQUIPMENT GROUNDING

- .1 Install grounding connections to typical equipment included in, but not necessarily limited to following list: Service equipment, distribution panels lighting controllers and lighting panels.

3.5 FIELD QUALITY CONTROL

- .1 Perform tests in accordance with Section 26 05 00 - Common Work Results for Electrical.
- .2 Perform ground continuity and resistance tests using method appropriate to site conditions and to approval of Consultant and local authority having jurisdiction over installation.
- .3 Perform tests before energizing electrical system.

3.6 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.
 - .1 Leave Work area clean at end of each day.

END OF SECTION

1.0 GENERAL

1.1 RELATED SECTIONS

- .1 Section 01 74 19 - Construction/Demolition Waste Management and Disposal.
- .2 Section 26 05 00 - Common Work Results - Electrical

1.2 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate and recycle waste materials in accordance with Section 01 74 19 - Construction/Demolition Waste Management and Disposal.
- .2 Remove from site and dispose of all packaging materials at appropriate recycling facilities.
- .3 Collect and separate for disposal packaging material for recycling in accordance with Waste Management Plan.
- .4 Divert unused metal materials from landfill to metal recycling facility as approved by Consultant.
- .5 Fold up metal banding, flatten and place in designated area for recycling.

2.0 PRODUCTS

2.1 SUPPORT CHANNELS

- .1 U shape, size 41 x 41 mm, 2.5 mm thick, surface mounted suspended or set in poured concrete walls and ceilings as required.

3.0 EXECUTION

3.1 INSTALLATION

- .1 Secure equipment to hollow or solid masonry, tile and plaster surfaces with lead anchors or nylon shields.
- .2 Secure equipment to poured concrete with expandable inserts.
- .3 Secure equipment to hollow masonry walls or suspended ceilings with toggle bolts.
- .4 Secure surface mounted equipment with twist clip fasteners to inverted T bar ceilings. Ensure that T bars are adequately supported to carry weight of equipment specified before installation.

- .5 Support equipment, conduit or cables using clips, spring loaded bolts, cable clamps designed as accessories to basic channel members.
- .6 Fasten exposed conduit or cables to building construction or support system using straps.
 - .1 One-hole steel straps to secure surface conduits and cables 50 mm and smaller.
 - .2 Two-hole steel straps for conduits and cables larger than 50 mm.
 - .3 Beam clamps to secure conduit to exposed steel work.
 - .4 Strap AC-90 cable at box location plus every 900 mm.
- .7 Suspended support systems.
 - .1 Support individual cable or conduit runs with 6 mm dia threaded rods and spring clips.
 - .2 Support 2 or more cables or conduits on channels supported by 6 mm dia threaded rod hangers where direct fastening to building construction is impractical.
- .8 For surface mounting of two or more conduits use channels at 1.5 m on centre spacing.
- .9 Provide metal brackets, frames, hangers, clamps and related types of support structures where indicated or as required to support conduit and cable runs.
- .10 Ensure adequate support for raceways and cables dropped vertically to equipment where there is no wall support.
- .11 Do not use wire lashing, wood blocking, plastic strap or perforated strap to support or secure raceways or cables.
- .12 Do not use supports or equipment installed for other trades for conduit or cable support except with permission of other trade and approval of Owner's Representative.
- .13 Install fastenings and supports as required for each type of equipment cables and conduits, and in accordance with manufacturer's installation recommendations.

END OF SECTION

1.0 GENERAL

1.1 RELATED SECTIONS

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

1.2 SHOP DRAWINGS AND PRODUCT DATA

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

1.3 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate and recycle waste materials in accordance with Section 01 74 19 – Construction / Demolition Waste Management and Disposal.
- .2 Remove from site and dispose of all packaging materials at appropriate recycling facilities.
- .3 Collect and separate for disposal packaging material for recycling in accordance with Waste Management Plan.
- .4 Divert unused metal materials from landfill to metal recycling facility as approved by Consultant.
- .5 Fold up metal banding, flatten and place in designated area for recycling.

2.0 PRODUCTS

2.1 SPLITTERS

- .1 Sheet metal enclosure, welded corners and formed hinged cover suitable for locking in closed position.
- .2 Main and branch lugs to match required size and number of incoming and outgoing conductors as indicated.
- .3 At least three spare terminals on each set of lugs in splitters less than 400 A.

2.2 JUNCTION AND PULL BOXES

- .1 Welded steel construction with screw-on flat covers for surface mounting.
 - .2 Covers with 25 mm minimum extension all around, for flush-mounted pull and junction boxes.
-

2.3 CABINETS

- .1 Type E: sheet steel, hinged door and return flange overlapping sides, handle, lock and catch, for surface mounting.
- .2 Type T: sheet steel cabinet, with hinged door, latch, lock, 2 keys, containing 19 mm fir plywood backboard for surface flush mounting.

3.0 EXECUTION

3.1 SPLITTER INSTALLATION

- .1 Install splitters and mount plumb, true and square to the building lines.
- .2 Extend splitters full length of equipment arrangement except where indicated otherwise.

3.2 JUNCTION, PULL BOXES AND CABINETS INSTALLATION

- .1 Install pull boxes in inconspicuous but accessible locations.
- .2 Mount cabinets with top not higher than 2 m above finished floor.
- .3 Install terminal block as indicated in Type T cabinets.
- .4 Only main junction and pull boxes are indicated. Install pull boxes so as not to exceed 30 m of conduit run between pull boxes.

3.3 IDENTIFICATION

- .1 Provide equipment identification in accordance with Section 26 05 00 – Common Work Results - Electrical.
- .2 Install size 2 identification labels indicating system name voltage and phase.

END OF SECTION

1.0 GENERAL

1.1 RELATED SECTIONS

- .1 Section 26 05 00 – Common Work Results – Electrical.
- .2 Section 26 05 29 – Hangers and Supports for Electrical Systems.
- .3 Section 26 05 34 – Conduits, Conduit Fastenings and Fittings.

1.2 REFERENCES

- .1 Canadian Standards Association (CSA)
 - .1 CSA C22.1, Canadian Electrical Code, Part 1.

1.3 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate and recycle waste materials in accordance with Section 01 74 19 – Construction / Demolition Waste Management and Disposal.
- .2 Remove from site and dispose of all packaging materials at appropriate recycling facilities.
- .3 Collect and separate for disposal packaging material for recycling in accordance with Waste Management Plan.
- .4 Divert unused metal materials from landfill to metal recycling facility as approved by Consultant.
- .5 Fold up metal banding, flatten and place in designated area for recycling.

2.0 PRODUCTS

2.1 OUTLET AND CONDUIT BOXES GENERAL

- .1 Size boxes in accordance with CSA C22.1.
- .2 102 mm square or larger outlet boxes as required for special devices.
- .3 Gang boxes where wiring devices are grouped.
- .4 Blank cover plates for boxes without wiring devices.
- .5 347 V outlet boxes for 347 V switching devices.
- .6 Combination boxes with barriers where outlets for more than one system are grouped.

2.2 GALVANIZED STEEL OUTLET BOXES

- .1 Electro-galvanized steel single and multi gang flush device boxes for flush installation, minimum size 76 x 50 x 38 mm or as indicated. 102 mm square outlet boxes when more than one conduit enters one side with extension and plaster rings as required.
- .2 Electro-galvanized steel utility boxes for outlets connected to surface-mounted EMT conduit, minimum size 102 x 54 x 48 mm.
- .3 102 mm square or octagonal outlet boxes for lighting fixture outlets.
- .4 102 mm square outlet boxes with extension and plaster rings for flush mounting devices in finished plaster walls.

2.3 MASONRY BOXES

- .1 Electro-galvanized steel masonry single and multi gang boxes for devices flush mounted in exposed block walls.

2.4 CONCRETE BOXES

- .1 Electro-glvanized sheet steel concrete type boxes for flush mount in concrete with matching extension and plaster rings as required.

2.5 FLOOR BOXES

- .1 Concrete tight electro-galvanized sheet steel floor boxes with adjustable finishing rings to suit floor finish with brass faceplate. Device mounting plate to accommodate short or long ear duplex receptacles. Minimum depth: 28 mm for receptacles; 73 mm for communication equipment.
- .2 Adjustable, watertight, concrete tight, cast floor boxes with openings drilled and tapped for 12 mm and 19 mm conduit. Minimum size: 73 mm deep.

2.6 CONDUIT BOXES

- .1 Cast FS or FD aluminum boxes with factory-threaded hubs and mounting feet for surface wiring of switches and receptacle.

2.7 OUTLET BOXES FOR NON-METALLIC SHEATHED CABLE

- .1 Electro-galvanized, sectional, screw ganging steel boxes, minimum size 76 x 50 x 63 mm with two double clamps to take non-metallic sheathed cables. For use in wood stud construction only.

2.8 FITTINGS - GENERAL

- .1 Bushing and connectors with nylon insulated throats.
- .2 Knock-out fillers to prevent entry of debris.
- .3 Conduit outlet bodies for conduit up to 32 mm and pull boxes for larger conduits.
- .4 Double locknuts and insulated bushings on sheet metal boxes.
- .5 Double split rings for AC-90 terminations.

2.9 SERVICE FITTINGS

- .1 'High tension' receptacle fitting made of 2 piece die-cast aluminum with brushed aluminum housing finish for 1 duplex receptacles. Bottom plate with two knockouts for centered or offset installation.
- .2 Pedestal type 'low tension' fitting made of 2 piece die cast aluminum with brushed aluminum housing finish to accommodate two amphenol jack connectors.

3.0 EXECUTION

3.1 INSTALLATION

- .1 Support boxes independently of connecting conduits.
- .2 Fill boxes with paper, sponges or foam or similar approved material to prevent entry of debris during construction. Remove upon completion of work.
- .3 For flush installations mount outlets flush with finished wall using plaster rings to permit wall finish to come within 6 mm of opening.
- .4 Provide correct size of openings in boxes for conduit, mineral insulated and armoured cable connections. Reducing washers are not allowed.
- .5 Vacuum clean interior of outlet boxes before installation of wiring devices.
- .6 Identify systems for outlet boxes as required.

END OF SECTION

1.0 GENERAL

1.1 SECTION INCLUDES

- .1 Materials and installation for cable splice and junction boxes.

1.2 RELATED SECTIONS

- .1 Section 01 33 00 - Submittal Procedures.
- .2 Section 01 74 19 – Construction / Demolition Waste Management and Disposal.

1.3 PRODUCT DATA

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

1.4 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate and recycle waste materials in accordance with Section 01 74 19 – Construction / Demolition Waste Management and Disposal.
- .2 Remove from site and dispose of all packaging materials at appropriate recycling facilities.
- .3 Collect and separate for disposal packaging material for recycling in accordance with Waste Management Plan.
- .4 Divert unused metal materials from landfill to metal recycling facility as approved by Consultant.
- .5 Fold up metal banding, flatten and place in designated area for recycling.

2.0 PRODUCTS

2.1 SPLICE BOXES

- .1 Splice boxes cast iron enclosures 6 mm thick painted with chromate primer and gray enamel to provide mechanical protection and moisture seal for cable splices rated 3 kV and higher and consisting of:
 - .1 Two halves, split along cable axis, finely ground matching surfaces, fastened with galvanized steel bolts, top half with large filling holes with gasketed plugs for medium hard asphalt base compound, bottom half with screws on inside for bonding armour, and box end openings sealed by:
 - .1 Wrapping cables with anhydrous tape and clamping to make snug fit, for 2-4 way splices.

- .2 Fitting boxes with cable entrance fittings suitable for sheaths as required, for 2-4 way splices.

2.2 JUNCTION BOXES DISTRIBUTION LEVEL

- .1 Welded steel rectangular boxes 6 mm thick painted with chromate primer and gray enamel with removable plate on front side, designed for through run of main cable and porcelain enclosed disconnecting branches of single conductor cables, using pothead plug and socket disconnectors enclosed in porcelain tubes and caps, standard designed for no voltage disconnecting, and for wall mounted, branch cables rated as indicated on drawings.

2.3 JUNCTION BOXES AND POWER LEVEL

- .1 Cast iron octagonal box painted with chromate primer and gray enamel with joints ground smooth and fitted with gasket, contacts mounted on porcelain supports to which conductors are fastened by soldered-on lugs, medium hard asphalt compound filled, suitable for 3 phase, 250 MCM maximum cable size, with stuffing box entrance.
- .2 Welded steel rectangular boxes, oil resistant gasketed steel plate lids fastened with silicon-bronze bolts, shot blasted and painted with chromate primer and gray enamel, cableheads medium hard asphalt compound filled capnut sealed potheads with stuffing box entrances, air filled, disconnecting links insulated switch stick operated at no voltage rated as indicated on drawings for wall mounting.

3.0 EXECUTION

3.1 INSTALLATION

- .1 Install splice boxes at cable joint. Tighten armour clamps and fill with compound.
- .2 Install junction boxes on trench floor around cable splice to CSA C22.2 No.40. Connect cable terminals to box contacts. Fasten lid securely and check for air leaks before trench is backfilled.
- .4 Install subway level steel boxes on wall of manholes. Connect cables to bus, install links, fasten lid and fill with compound.
- .5 Install distribution level steel boxes on walls of manholes. Splice main cable in box and connect branch feeder. Fasten cover and fill with compound.
- .6 Install power level boxes as follows:
 - .1 Cast iron type: on trench floor, connect cable terminals to box contacts, fasten lid and fill with compound before trench is backfilled.



- .2 Steel type: mount on wall of manhole; connect cables to box terminals; install disconnect links, fasten lid securely check for air leaks.

END OF SECTION

1.0 GENERAL

1.1 REFERENCES

- .1 Canadian Standards Association (CSA)
- .2 CAN/CSA C22.2 No. 18, Outlet Boxes, Conduit Boxes, and Fittings and Associated Hardware.
- .3 CSA C22.2 No. 56, Flexible Metal Conduit and Liquid-Tight Flexible Metal Conduit.
- .4 CSA C22.2 No. 83, Electrical Metallic Tubing.
- .5 CSA C22.2 No. 211.2, Rigid PVC (Unplasticized) Conduit.
- .6 CAN/CSA C22.2 No. 227.3, Flexible Nonmetallic Tubing.

1.2 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate and recycle waste materials in accordance with Section 01 74 19 – Construction / Demolition Waste Management and Disposal.
- .2 Remove from site and dispose of all packaging materials at appropriate recycling facilities.
- .3 Collect and separate for disposal packaging material for recycling in accordance with Waste Management Plan.
- .4 Divert unused metal materials from landfill to metal recycling facility as approved by Consultant.
- .5 Fold up metal banding, flatten and place in designated area for recycling.

2.0 PRODUCTS

2.1 CONDUITS

- .1 Epoxy coated conduit: to CSA C22.2 No. 45, with zinc coating and corrosion resistant epoxy finish inside and outside.
- .2 Electrical metallic tubing (EMT): to CSA C22.2 No. 83, with couplings.
- .3 Rigid pvc conduit: to CSA C22.2 No. 211.2.
- .4 Flexible metal conduit: to CSA C22.2 No. 56, liquid-tight flexible metal.

- .5 Flexible pvc conduit: to CAN/CSA-C22.2 No. 227.3.

2.2 CONDUIT FASTENINGS

- .1 One hole steel straps to secure surface conduits 50 mm and smaller. Two hole steel straps for conduits larger than 50 mm.
- .2 Beam clamps to secure conduits to exposed steel work.
- .3 Channel type supports for two or more conduits at 3 m oc.
- .4 Threaded rods, 6 mm dia., to support suspended channels.

2.3 CONDUIT FITTINGS

- .1 Fittings: manufactured for use with conduit specified. Coating: same as conduit.
- .2 Factory "ells" where 90° bends are required for 25 mm and larger conduits.
- .3 Watertight connectors and couplings for EMT. Set-screws are not acceptable.

2.4 EXPANSION FITTINGS FOR RIGID CONDUIT

- .1 Weatherproof expansion fittings with internal bonding assembly suitable for 200 mm linear expansion.
- .2 Watertight expansion fittings with integral bonding jumper suitable for linear expansion and 19 mm deflection in all directions.
- .3 Weatherproof expansion fittings for linear expansion at entry to panel.

2.5 FISH CORD

- .1 Polypropylene.

3.0 EXECUTION

3.1 INSTALLATION

- .1 Install conduits to conserve headroom in exposed locations and cause minimum interference in spaces through which they pass.
- .2 Conceal conduits except in mechanical and electrical service rooms.
- .3 Surface mount conduits except as noted.

- .4 Use electrical metallic tubing (EMT) where not subject to mechanical injury.
- .5 Use rigid pvc conduit underground and in corrosive areas.
- .6 Use flexible metal conduit for connection to motors in dry areas.
- .7 Use liquid tight flexible metal conduit for connection to motors or vibrating equipment in damp, wet or corrosive locations.
- .8 Minimum conduit size for lighting and power circuits: 19 mm.
- .9 Bend conduit cold. Replace conduit if kinked or flattened more than 1/10th of its original diameter.
- .10 Mechanically bend steel conduit over 19 mm dia.
- .11 Install fish cord in empty conduits.
- .12 Run 2 25 mm spare conduits up to ceiling space and 2 25 mm spare conduits down to ceiling space from each flush panel. Terminate these conduits in 152 x 152 x 102 mm junction boxes in ceiling space or in case of an exposed concrete slab, terminate each conduit in surface type box.
- .13 Remove and replace blocked conduit sections. Do not use liquids to clean out conduits.
- .14 Dry conduits out before installing wire.

3.2 SURFACE CONDUITS

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

3.3 CONCEALED CONDUITS

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

3.4 CONDUITS IN CAST-IN-PLACE CONCRETE

- .1 Locate to suit reinforcing steel. Install in centre one third of slab.
- .2 Protect conduits from damage where they stub out of concrete.
- .3 Install sleeves where conduits pass through slab or wall.
- .4 Provide oversized sleeve for conduits passing through waterproof membrane, before membrane is installed. Use cold mastic between sleeve and conduit.
- .5 Do not place conduits in slabs in which slab thickness is less than 4 times conduit diameter.
- .6 Encase conduits completely in concrete with minimum 25 mm concrete cover.
- .7 Organize conduits in slab to minimize cross-overs.

3.5 CONDUITS IN CAST-IN-PLACE SLABS ON GRADE

- .1 Run conduits 25 mm and larger below slab and encased in 75 mm concrete envelope. Provide 50 mm of sand over concrete envelope below floor slab.

3.6 CONDUITS UNDERGROUND

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

END OF SECTION

1.0 GENERAL

1.1 RELATED SECTIONS

- .1 Section 01 74 21 – Construction/Demolition Waste Management and Disposal.
- .2 Section 26 05 00 - Common Work Results - Electrical.

1.2 REFERENCES

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

2.0 PRODUCTS

2.1 CABLE PROTECTION

- .1 38 x 140 mm planks pressure treated with copper naphthenate or 5% pentachlorophenol solution, water repellent preservative.

2.2 MARKERS

- .1 Concrete type cable markers: 600 x 600 x 100 mm with words: cable, joint or conduit impressed in top surface, with arrows to indicate change in direction of cable and duct runs.
- .2 Wooden post type markers: 89 x 89 mm, 1.5 m long, pressure treated with copper naphthenate or 5% pentachlorophenol solution, water repellent preservative, with nameplate fastened near post top, on side facing cable or conduit to indicate depth and direction of duct and cable runs.
 - .1 Nameplate: aluminum anodized 89 x 125 mm, 1.5 mm thick mounted on cedar post with mylar label 0.125 mm thick with words Cable, Joint or Conduit with arrows to indicate change in direction.

3.0 EXECUTION

3.1 CABLE INSTALLATION IN DUCTS

- .1 Install cables as indicated in ducts.
 - .1 Do not pull spliced cables inside ducts.
- .2 Install multiple cables in duct simultaneously.

- .3 Use CSA approved lubricants of type compatible with cable jacket to reduce pulling tension.
- .4 To facilitate matching of colour coded multiconductor control cables reel off in same direction during installation.
- .5 Before pulling cable into ducts and until cables are properly terminated, seal ends of lead covered cables with wiping solder; seal ends of non-leaded cables with moisture seal tape.
- .6 After installation of cables, seal duct ends with duct sealing compound.

3.2 MARKERS

- .1 Mark cable every 150 m along cable runs and changes in direction.
- .2 Mark underground splices.
- .3 Where markers are removed to permit installation of additional cables, reinstall existing markers.
- .4 Install wooden post type markers.
- .5 Lay concrete markers flat and centred over cable with top flush with finish grade.

3.3 FIELD QUALITY CONTROL

- .1 Perform tests in accordance with Section 26 05 00 - Common Work Results - Electrical and Section 01 91 13.13 – Commissioning (Cx) Requirements.
- .2 Perform tests using qualified personnel. Provide necessary instruments and equipment.
- .3 Check phase rotation and identify each phase conductor of each feeder.
- .4 Check each feeder for continuity, short circuits and grounds. Ensure resistance to ground of circuits is not less than 50 megohms.
- .5 Pre-acceptance tests.
 - .1 After installing cable but before splicing and terminating, perform insulation resistance test with 1000 V megger on each phase conductor.
 - .2 Check insulation resistance after each splice and/or termination to ensure that cable system is ready for acceptance testing.



- .6 Acceptance Tests
 - .1 Ensure that terminations and accessory equipment are disconnected.
 - .2 Ground shields, ground wires, metallic armour and conductors not under test.
 - .3 High Potential (Hipot) Testing.
 - .1 Conduct hipot testing at 100 % of original factory test voltage in accordance with manufacturer's recommendations.
 - .4 Leakage Current Testing.
 - .1 Raise voltage in steps from zero to maximum values as specified by manufacturer for type of cable being tested.
 - .2 Hold maximum voltage for specified time period by manufacturer.
 - .3 Record leakage current at each step.
- .7 Provide Owner's Representative with list of test results showing location at which each test was made, circuit tested and result of each test. Include results in Commissioning Manual.
- .8 Remove and replace entire length of cable if cable fails to meet any of test criteria.

END OF SECTION

1.0 GENERAL

1.1 SCOPE

- .1 The contractor shall furnish short-circuit and protective device coordination studies as prepared by the electrical equipment manufacturer or an approved engineering firm.
- .2 The contractor shall furnish an Arc Flash Hazard Analysis Study per the requirements set forth in CSA Z462 – Workplace Electrical Safety.
- .3 The scope of the studies shall include all distribution and equipment.

1.2 REFERENCES

- .1 American National Standards Institute (ANSI):
 - .1 ANSI C37.010 – Standard Application Guide for AC High Voltage Circuit Breakers Rated on a Symmetrical Current Basis.
 - .2 ANSI C37.13 – Standard for Low Voltage AC Power Circuit Breakers Used in Enclosures.
 - .3 ANSI C 37.41 – Standard Design Tests for High Voltage Fuses, Distribution Enclosed Single-Pole Air Switches, Fuse Disconnecting Switches and Accessories.
 - .4 ANSI C57.12.00 – Standard General Requirements for Liquid-Immersed Distribution, Power, and Regulating Transformers.
 - .2 CSA Group (CSA)
 - .1 CSA Z462-15 – Workplace Electrical Safety.
 - .3 Institute of Electrical and Electronics Engineers, Inc. (IEEE):
 - .1 IEEE 141 – Recommended Practice for Electric Power Distribution and Coordination of Industrial and Commercial Power Systems.
 - .2 IEEE 241 – Recommended Practice for Electric Power Systems in Commercial Buildings.
 - .3 IEEE 242 – Recommended Practice for Protection and Coordination of Industrial and Commercial Power Systems.
 - .4 IEEE 399 – Recommended Practice for Industrial and Commercial Power System Analysis.
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- .5 IEEE 1015 – Recommended Practice for Applying Low-Voltage Circuit Breakers Used in Industrial and Commercial Power Systems.
- .6 IEEE 1584 – Guide for Performing Arc-Flash Hazard Calculations.
- .4 The National Fire Protection Association (NFPA)
 - .1 NFPA 70 - National Electrical Code.
 - .2 NFPA 70E – Standard for Electrical Safety in the Workplace.

1.3 SUBMITTALS

- .1 Submittals: in accordance with Section 01 33 00 - Submittal Procedures.
- .2 The short-circuit and protective device coordination studies shall be submitted to the Owner's Representative prior to receiving final approval of the distribution equipment shop drawings and / or prior to release of equipment drawings for manufacturing. If formal completion of the studies may cause delay in equipment manufacturing and/or project schedule, approval from the Owner's Representative may be obtained for preliminary submittal of sufficient study data to ensure that the selection of device and characteristics will be satisfactory.
- .3 The results of the short-circuit, protective device coordination and arc flash hazard analysis studies shall be summarized in a final report.
- .4 The report shall include the following sections:
 - .1 One-line diagram showing protective device ampere ratings and associated designations, cable size and lengths, transformer kVA and voltage ratings, motor and generator kVA ratings, and switchgear / switchboard / panelboard designations.
 - .2 Descriptions, purpose, basis and scope of the study.
 - .3 Tabulations of the worst-case calculated short circuit duties as a percentage of the applied device rating (automatic transfer switches, circuit breakers, fuses, etc.); the short circuit duties shall be upward-adjusted for X/R ratios that are above the device design ratings.
 - .4 Protective device time versus current coordination curves with associated one line diagram identifying the plotted devices, tabulations of ANSI protective relay functions and adjustable circuit breaker trip unit settings.
 - .5 Fault study input data, case descriptions, and current calculations including a definition of terms and guide for interpretation of the computer printout.
 - .6 Incident energy and flash protection boundary calculations.

- .7 Comments and recommendations for system improvements, where needed.
- .8 Executive Summary including source of information and assumptions made.

1.4 QUALIFICATIONS

- .1 The short-circuit, protective device coordination and arc flash hazard analysis studies shall be conducted under the supervision and approval of a Registered Professional Electrical Engineer skilled in performing and interpreting the power system studies.
- .2 The Registered Professional Electrical Engineer shall be an approved engineering firm and be registered to practice in the Province of Ontario.
- .3 The Registered Professional Electrical Engineer shall have a minimum of five (5) years of experience in performing power system studies.
- .4 The equipment manufacturer or approved engineering firm shall demonstrate experience with Arc Flash Hazard Analysis by submitting qualifications at the request of the Owner.

2.0 PRODUCTS

2.1 STUDIES

- .1 Contractor to furnish short-circuit and protective device coordination studies as prepared by equipment manufacturer or an approved engineering firm. The coordination new and / or modified study shall begin with the utility company's feeder protective device and include all of the electrical protective devices down to and include the largest feeder circuit breaker in the 208 Volt panelboards. Study shall also include variable frequency drives, harmonic filters, power factor correction equipment, transformers and protective devices associated with variable frequency drives, emergency standby generator and distribution switchgear.
- .2 The contractor shall furnish an Arc Flash Hazard Analysis Study per CSA Z462.

2.2 DATA COLLECTION

- .1 Contractor shall furnish all data as required by the power system studies. The Engineer performing the short-circuit, protective device coordination and arc flash hazard analysis studies shall furnish the Contractor with a listing of required data immediately after award of the contract. The Contractor shall expedite collection of the data to assure completion of the studies as required for final approval of the distribution equipment shop drawings and/or prior to the release of the equipment for manufacturing.
- .2 Source combination may include present and future utility supplies, motors, and generators.

- .3 If applicable, include fault contribution of existing motors in the study. The Contractor shall obtain required existing equipment data, if necessary, to satisfy the study requirements.

2.3 SHORT-CIRCUIT AND PROTECTIVE DEVICE EVALUATION STUDY

- .1 Use actual conductor impedances if known. If unknown, use typical conductor impedances based on IEEE Standard 141, latest edition.
- .2 Transformer design impedances and standard X/R ratios shall be used when test impedances are not available.
- .3 Provide the following:
 - .1 Calculation methods and assumptions.
 - .2 Selected base per unit quantities.
 - .3 One-line diagram of the system being evaluated with available fault at each bus, and interrupting rating of devices noted.
 - .4 Source impedance data, including electric utility system and motor fault, contribution characteristics.
 - .5 Tabulations of calculated quantities.
 - .6 Results, conclusions, and recommendations.
- .4 Calculate short-circuit momentary and interrupting duties for a three-phase bolted fault at each:
 - .1 Electric utility's supply termination point.
 - .2 Low voltage switchgear.
 - .3 Branch circuit panelboards.
 - .4 Other significant locations throughout the system.
- .5 For grounded systems, provide a bolted line-to-ground fault current study for areas as defined for the three-phase bolted fault short-circuit study.
- .6 Protective Device Evaluation:
 - .1 Evaluate equipment and protective devices and compare to short circuit ratings.

- .2 Adequacy of switchgear, motor control centers, and panelboard bus bracing to withstand short-circuit stresses.
- .3 Adequacy of transformer windings to withstand short-circuit stresses.
- .4 Cable and busway sizes for ability to withstand short-circuit heating.

2.4 PROTECTIVE DEVICE COORDINATION STUDY

- .1 Proposed protective device coordination time-current curves (TCC) shall be displayed on log-log scale graphs.
- .2 Include on each curve sheet, a complete title and one-line diagram with legend identifying the specific portion of the system covered.
- .3 Terminate device characteristic curves at a point reflecting maximum symmetrical or asymmetrical fault current to which device is exposed.
- .4 Identify device associated with each curve by manufacturer type, function, and, if applicable, tap, time delay, and instantaneous settings recommended.
- .5 Plot the following characteristics on the curve sheets, where applicable:
 - .1 Electric utility's overcurrent protective device.
 - .2 Low voltage fuses including manufacturer's minimum melt, total clearing, tolerance, and damage bands.
 - .3 Low voltage equipment circuit breaker trip devices, including manufacturer's tolerance bands.
 - .4 Transformer full-load current, magnetizing inrush current, and ANSI through-fault protection curves.
 - .5 Conductor damage curves.
 - .6 Ground fault protective devices, as applicable.
 - .7 Pertinent motor starting characteristics and motor damage points, where applicable.
 - .8 Pertinent generator short-circuit decrement curve and generator damage point.
- .6 Provide adequate time margins between device characteristics such that selective operation is provided, while providing proper protection.

2.5 ARC FLASH HAZARD ANALYSIS

- .1 The arc flash hazard analysis shall be performed according to CSA Z462.
 - .2 The flash protection boundary and the incident energy shall be calculated at all significant locations in the electrical distribution system (switchboards, switchgear, panelboards, busway and splitters) where work could be performed on energized parts.
 - .3 The Arc-Flash Hazard Analysis shall include all new and/or modified equipment where work could be performed on energized parts.
 - .4 Safe working distances shall be based upon the calculated arc flash boundary considering an incident energy of 1.2 cal/cm².
 - .5 When appropriate, the short circuit calculations and the clearing times of the phase overcurrent devices will be retrieved from the short-circuit and coordination study model. Ground overcurrent relays should not be taken into consideration when determining the clearing time when performing incident energy calculations.
 - .6 The short-circuit calculations and the corresponding incident energy calculations for multiple system scenarios must be compared and the greatest incident energy must be uniquely reported for each equipment location. Calculations must be performed to represent the maximum and minimum contributions of fault current magnitude for all normal and emergency operating conditions. The minimum calculation will assume that the utility contribution is at a minimum and will assume a minimum motor contribution (all motors off). Conversely, the maximum calculation will assume a maximum contribution from the utility and will assume the maximum amount of motors to be operating.
 - .7 The incident energy calculations must consider the accumulation of energy over time when performing arc flash calculations on buses with multiple sources. Iterative calculations must take into account the changing current contributions, as the sources are interrupted or decremented with time. Fault contribution from motors and generators should be decremented as follows:
 - .1 Fault contribution from induction motors should not be considered beyond 3-5 cycles.
 - .2 Fault contribution from synchronous motors and generators should be decayed to match the actual decrement of each as closely as possible (e.g. contributions from permanent magnet generators will typically decay from 10 per unit to 3 per unit after 10 cycles).
 - .8 For each equipment location with a separately enclosed main device (where there is adequate separation between the line side terminals of the main protective device and the work location), calculations for incident energy and flash protection boundary shall include both the line and load side of the main breaker.
 - .9 Where performing incident energy calculations on the line side of a main breaker (as required per above), the line side and load side contributions must be included in the fault calculation.
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- .10 Mis-coordination should be checked amongst all devices within the branch containing the immediate protective device upstream of the calculation location and the calculation should utilize the fastest device to compute the incident energy for the corresponding location.
- .11 Arc Flash calculations shall be based on actual overcurrent protective device clearing time.

2.6 REPORT SECTIONS

- .1 Input data shall include but not be limited to the following:
 - .1 Utility 3-phase and L-G available contribution with associated X/R ratios.
 - .2 Feeder input data including feeder type (cable or bus), size, length, number per phase, conduit type (magnetic or non-magnetic) and conductor material (copper or aluminum).
 - .3 Transformer input data, including winding connections, secondary neutral- ground connection, primary and secondary voltage ratings, kVA rating, impedance, % taps and phase shift.
 - .4 Reactor data, including voltage rating, and impedance.
 - .5 Generation contribution data, (synchronous generators and Utility), including short-circuit reactance (X''_d), rated MVA, rated voltage, three-phase and single line-ground contribution (for Utility sources) and X/R ratio.
 - .6 Motor contribution data (induction motors and synchronous motors), including short circuit reactance, rated horsepower or kVA, rated voltage, and X/R ratio.
- .2 Short-Circuit Output Data shall include, but not be limited to the following reports:
 - .1 Low voltage Fault Report shall include a section for three-phase and unbalanced fault calculations and shall show the following information for each application location:
 - .1 Voltage
 - .2 Calculated fault current magnitude and angle
 - .3 Fault point X/R ratio
 - .4 Equivalent impedance
 - .2 Momentary Duty Report shall include a section for three-phase and unbalanced fault calculations and shall show the following information for each applicable location:
 - .1 Voltage

- .2 Calculated symmetrical fault current magnitude and angle
- .3 Fault point X/R ratio
- .4 Calculated asymmetrical fault currents
 - .1 Based on fault point X/R ratio
 - .2 Based on calculated symmetrical value multiplied by 1.6
 - .3 Based on calculated symmetrical value multiplied by 2.7
- .5 Equivalent impedance.
- .3 Interrupting Duty Report shall include a section for three-phase and unbalanced fault calculations and shall show the following information for each applicable location:
 - .1 Voltage.
 - .2 Calculated symmetrical fault current magnitude and angle.
 - .3 Fault point X/R ratio.
 - .4 No AC Decrement (NACD) Ratio.
 - .5 Equivalent impedance.
 - .6 Multiplying factors for 2, 3, 5 and 8 cycle circuit breakers rated on a symmetrical basis.
 - .7 Multiplying factors for 2, 3, 5 and 8 cycle circuit breakers rated on a total basis.
- .3 Recommended Protective Device Settings:
 - .1 Phase and Ground Relays:
 - .1 Current transformer ratio.
 - .2 Current setting.
 - .3 Time setting.
 - .4 Instantaneous setting.
 - .5 Recommendations on improved relaying systems, if applicable.

- .2 Circuit Breakers:
 - .1 Adjustable pickups and time delays (long time, short time, ground)
 - .2 Adjustable time-current characteristic.
 - .3 Adjustable instantaneous pickup.
 - .4 Recommendations on improved trip systems, if applicable.
- .4 Incident energy and flash protection boundary calculations:
 - .1 Arcing fault magnitude.
 - .2 Protective device clearing time.
 - .3 Duration of arc.
 - .4 Arc flash boundary.
 - .5 Working distance.
 - .6 Incident energy.
 - .7 Hazard Risk Category.
 - .8 Recommendations for arc flash energy reduction.

3.0 EXECUTION

3.1 FIELD ADJUSTMENT

- .1 Adjust relay and protective device settings according to the recommended settings table provided by the coordination study.
- .2 Make minor modifications to equipment as required to accomplish conformance with short circuit and protective device coordination studies.
- .3 Notify Owner's Representative in writing of any required major equipment modifications.

3.2 ARC FLASH WARNING LABELS

- .1 The contractor of the Arc Flash Hazard Analysis shall provide a 90mm x 617mm thermal transfer type label of high adhesion polyester for each work location analyzed.

- .2 All labels will be based on recommended overcurrent device settings and will be provided after the results of the analysis have been presented to the owner and after any system changes, upgrades or modifications have been incorporated in the system.
- .3 The label shall have an orange header with the working: “WARNING: ARC FLASH HAZARD” and shall include the following information, at a minimum:
 - .1 Location designation
 - .2 Nominal voltage
 - .3 Flash protection boundary
 - .4 Hazard risk category
 - .5 Incident energy
 - .6 Working distance
 - .7 Engineering report number, revision number and issue date.
- .4 Labels shall be machine printed, with no field markings.
- .5 Arc flash labels shall be provided in the following manner and all labels shall be based on recommended overcurrent device settings.
 - .1 For each 600 and 208 volt panelboard, one arc flash label shall be provided.
 - .2 For each motor control center, one arc flash label shall be provided.
 - .3 For each low voltage switchboard, one arc flash label shall be provided.
 - .4 For each switchgear, one flash label shall be provided.
 - .5 For medium voltage switches one arc flash label shall be provided.

3.3 EXECUTION

- .1 Coordinate requirements of this Section with information contained in Section 02 41 19.16 - Selective Interior Demolition and as follows:
 - .1 Disconnect electrical circuits and panel feeders; maintain electrical service and main distribution panel as is, ready for subsequent Work.

- .2 Remove existing luminaires, electrical devices and equipment including associated conduits, boxes, wiring, and similar items unless specifically noted otherwise.
- .3 Disconnect and remove existing fire alarm system including associated conduits, boxes, wiring, and similar items unless specifically noted otherwise.
- .4 Disconnect and remove communication systems including associated conduits, boxes, cabling, and similar items unless specifically noted otherwise.
- .5 Disconnect and remove telephone outlets, associated conduit, cabling and sub terminal backboards and related accessories; maintain telephone service and main terminal backboard as is.
- .6 Perform demolition work in a neat and workmanlike manner:
 - .1 Remove tools or equipment after completion of work, and leave site clean and ready for subsequent renovation work.
 - .2 Repair and restore damages caused as a result of work of this Section to match existing materials and finishes.
- .7 Disconnect panel feeders back to main distribution panel and re label respective circuit breaker as "SPARE".
- .8 Place weatherproof blank cover plates on exterior outlet boxes remaining after demolition and removal activities.
- .9 Remove existing conduits, boxes, cabling and wiring associated with removed luminaires, electrical devices and equipment.
- .10 Grind off conduits and make flush with surface of concrete where conduits are cast into concrete; seal open ends of conduit with silicone sealant and leave in place.
- .11 Seal open ends of conduit with silicone sealant and leave in place where they are inaccessible or cannot be removed without damaging adjacent construction.

3.4 CLOSEOUT ACTIVITIES

- .1 Arrange for legal disposal and remove demolished materials to accredited provincial landfill site or alternative disposal site (recycle centre) except where explicitly noted otherwise for materials being salvaged for re use in new construction.

END OF SECTION

1.0 GENERAL

1.1 REFERENCES

- .1 Canadian Standards Association (CSA International).
 - .1 CSA C22.2 No. 100, Motors and Generators.
 - .2 CSA C22.2 No. 145-M1986, Motors and Generators for Use in Hazardous Locations.
- .2 Electrical and Electronic Manufacturers' Association of Canada (EEMAC).
 - .1 EEMAC M1-7-1992 or latest revision, Standard for Motors and Generators.

1.2 PRODUCT DATA

- .1 Submit product data in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Submit WHMIS MSDS - Material Safety Data Sheets in accordance with Section 02 61 33 - Hazardous Materials.
- .3 Submit product data sheets for motors. Include product characteristics, performance criteria, physical size, horsepower, watt rating, limitations and finish.

1.3 SHOP DRAWINGS

- .1 Submit shop drawings in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Indicate dimensions, recommended installation procedure, wiring diagrams, sizes and location of mounting bolt holes and recommended support method.
- .3 Quality Assurance Submittals:
 - .1 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
 - .2 Manufacturer's Instructions: submit manufacturer's installation instructions.

1.4 CLOSEOUT SUBMITTALS

- .1 Provide maintenance data for fractional horsepower motors for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.

1.5 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate and recycle waste materials in accordance with Section 01 74 19 – Construction / Demolition Waste Management and Disposal.
- .2 Remove from site and dispose of all packaging materials at appropriate recycling facilities.
- .3 Collect and separate for disposal packaging material for recycling in accordance with Waste Management Plan.
- .4 Divert unused metal materials from landfill to metal recycling facility as approved by Consultant.
- .5 Fold up metal banding, flatten and place in designated area for recycling.

2.0 PRODUCTS

2.1 FRACTIONAL HORSEPOWER MOTOR

- .1 Non-hazardous locations: to CSA C22.2 No. 100 and EEMAC M1-7.
- .2 Hazardous locations: to CSA C22.2 No. 145.
 - .1 Rating: As indicated.
 - .2 Type: As indicated.
 - .3 Bearings: As indicated.
 - .4 Frame size: As indicated.
 - .5 Enclosure: As indicated.
 - .6 Mounting: As indicated.
- .3 Motor with inherent overheating protectors.

3.0 EXECUTION

3.1 MANUFACTURER'S INSTRUCTIONS

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

3.2 INSTALLATION

- .1 Install wiring, flexible connections and grounding.

- .2 Check rotation before coupling to driven equipment.

3.3 CLEANING

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

END OF SECTION

1.0 GENERAL

1.1 REFERENCES

- .1 Electrical and Electronic Manufacturer's Association of Canada (EEMAC).
 - .1 EEMAC M1-7, Motors and Generators.
 - .2 EEMAC M2-1, Lead Marking and Connections for Polyphase Induction Motors.

1.2 PRODUCT DATA

- .1 Submit product data in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Submit WHMIS MSDS - Material Safety Data Sheets in accordance with Section 02 61 33 - Hazardous Materials.
- .3 Submit product data sheets for motors. Include product characteristics, performance criteria, physical size, horsepower, watt rating, limitations and finish.
- .4 Manufacturer's Instructions: Provide to indicate special handling criteria, installation sequence, cleaning procedures.

1.3 SHOP DRAWINGS

- .1 Submit shop drawings in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Indicate:
 - .1 Overall dimensions of motor.
 - .2 Shaft centreline to base dimension.
 - .3 Shaft extension diameter and keyway, coupling dimensions and details.
 - .4 Fixing support dimensions.
 - .5 Dimensioned position of ventilation openings. Details of ventilation duct attachments.
 - .6 Terminal box location and size of terminals.
 - .7 Arrangement and dimensions of accessories.
 - .8 Diagram of connections.

- .9 Starting current and relative data necessary for use in design of motor starting equipment.
- .10 Speed / torque characteristic.
- .11 Weight.
- .12 Installation data.

1.4 CLOSEOUT SUBMITTALS

- .1 Provide maintenance data for motors for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.
- .2 Data necessary for maintenance of motors.
- .3 Manufacturer's recommended list of spare parts.

1.5 DELIVERY, STORAGE AND HANDLING

- .1 Handle motors with suitable lifting equipment.
- .2 Store motors in heated, dry, weather-protected enclosure.

1.6 QUALITY ASSURANCE

- .1 Engineer reserves the right to witness standard factory testing of motors 50 hp and above.

1.7 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate and recycle waste materials in accordance with Section 01 74 19 – Construction / Demolition Waste Management and Disposal.
- .2 Remove from site and dispose of all packaging materials at appropriate recycling facilities.
- .3 Collect and separate for disposal packaging material for recycling in accordance with Waste Management Plan.
- .4 Divert unused metal materials from landfill to metal recycling facility as approved by Consultant.
- .5 Fold up metal banding, flatten and place in designated area for recycling.

1.8 EXTRA MATERIALS

- .1 Provide maintenance materials and spare parts in accordance with Section 01 78 00 - Closeout Submittals.

2.0 PRODUCTS

2.1 HORSEPOWER MOTOR

2.2 MATERIALS

- .1 Motors: to EEMAC M1-7.
- .2 Lead markings: to EEMAC M2-1.
- .3 Rating: As indicated.
- .4 Motor Type: As indicated on drawings.
- .5 Service Factor: 1.15.

2.3 DESIGN LETTERS

- .1 Polyphase squirrel cage induction motors design As Indicated.

2.4 ENCLOSURE

- .1 Totally enclosed fan cooled.
- .2 Totally enclosed explosion proof for use in: Class as Indicated.

2.5 INSULATION

- .1 Class: as indicated on drawings.
- .2 Ambient temperature: 40 °C or as indicated.

2.6 BEARINGS

- .1 Antifriction type bearings, fitted with readily accessible facilities for lubrication while motor running or stationary.

2.7 STARTING METHOD

- .1 All motors shall be Inverter Duty rated.
- .2 Include anchor devices and setting templates

3.0 EXECUTION

3.1 INSTALLATION

- .1 Dry out motor if dampness present in accordance with manufacturer's instructions.
- .2 Install wiring, flexible connections and grounding.
- .3 Make wiring connections. Use liquid tight PVC jacketed flexible conduit between rigid conduit and motor.
- .4 Make flexible conduit long enough to permit movement of motor over entire length of slide rails.
- .5 Check for correct direction of rotation with motor uncoupled from driven equipment.
- .6 Align and couple motor to driven machinery to manufacturer's instructions, using only correct parts such as couplings, belts, sheaves, as provided by manufacturer.

3.3 FIELD QUALITY CONTROL

- .1 Perform tests in accordance with Section 26 05 00 - Common Work Results – Electrical.

END OF SECTION

1.0 GENERAL

1.1 RELATED SECTIONS

- .1 Section 01 33 00 – Submittal Procedures.
- .2 Section 01 78 00 – Closeout Procedures.
- .3 Section 26 05 00 – Common Work Results - Electrical.

1.2 SYSTEM DESCRIPTION

- .1 Low voltage control system designed to provide remote switching of lighting loads by use of:
 - .1 Low voltage momentary contact switches.
 - .2 Low voltage relays.
 - .3 Control Transformers
 - .4 Low voltage rectifiers.
 - .5 Manual switch control.

1.3 PRODUCT DATA

- .1 Submit manufacturer's printed product literature, specifications and datasheet. Include product characteristics, performance criteria, and limitations.
 - .1 Submit two copies of Workplace Hazardous Materials Information System (WHMIS) Material Safety Data Sheets (MSDS).

1.4 SHOP DRAWINGS

- .1 Submit shop drawings in accordance with Division 01 - Submittal Procedures.

1.5 CLOSEOUT DOCUMENTS

- .1 Submit maintenance data in accordance with Section 01 78 00 Closeout Submittals.

1.6 TEST REPORTS

- .1 Submit certified test reports indicating compliance with specifications for specified performance characteristics and physical properties.

- .2 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
- .3 Manufacturer's Instructions: submit manufacturer's installation instructions.
- .4 Manufacturer's Field Reports: manufacturer's field reports specified.

1.7 QUALITY ASSURANCE

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

1.8 DELIVERY, STORAGE, AND HANDLING

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

1.9 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate and recycle waste materials in accordance with Section 01 74 19 – Construction / Demolition Waste Management and Disposal.
- .2 Remove from site and dispose of all packaging materials at appropriate recycling facilities.
- .3 Collect and separate for disposal packaging material for recycling in accordance with Waste Management Plan.
- .4 Divert unused metal materials from landfill to metal recycling facility as approved by Consultant.
- .5 Fold up metal banding, flatten and place in designated area for recycling.

2.0 PRODUCTS

2.1 MATERIALS

- .1 Control system: by one manufacturer and assembled from compatible components.

2.2 REMOTE CONTROL SWITCHES

- .1 Single pole, double throw, momentary contact, heavy duty, rated 3 A, 25 V, centre pivot rocker action with pilot lights where indicated.

2.3 LOW VOLTAGE RELAYS

- .1 Electrically operated by momentary impulse, mechanically latched until activated.
- .2 Two coil solenoid type with one coil to close relay contacts and one coil to open relay contacts.
- .3 Operating voltage: 24 V, AC.
- .4 Load contacts: 20 A, 120 or 347 V, AC as indicated.
- .5 Auxiliary contacts for pilot light.
- .6 Coloured pre-stripped leads.

2.4 CONTROL TRANSFORMER

- .1 Low voltage power Class 2, input 120 or 347 V, AC, 60 Hz, output 35 VA at 24 V.

2.5 RECTIFIER

- .1 Selenium type: 24 V, AC, 60 Hz input, 0.36 A continuous duty output.
- .2 Silicon type: 24 V, AC, 60 Hz input, 7.5 A continuous duty output.

2.6 MANUAL CONTROL

- .1 Individual remote control switches as indicated.
- .2 Eight circuit manual master selector switch mounted in 100 mm square box with:
 - .1 Master lock-out switch
 - .2 Individual red jewelled pilot lights.
- .3 Nine circuit manual dial-type master selector.
- .4 Twelve circuit manual dial-type master selector.

2.7 MOTOR OPERATED MASTER CONTROL

- .1 Motor-driven multiple contact momentary switching device.
- .2 Radial contact arm to rotate through one revolution in 17 s.

- .3 Contact made in succession between 25 points around circle.
- .4 One master required for "ON" operation and one for "OFF" operation.
- .5 Motor master units connected in cascade to control circuits as indicated.
- .6 Interface equipment as required to convert maintained contact signals to momentary contact control pulses.

3.0 EXECUTION

3.1 INSTALLATION

- .1 Locate and install equipment in accordance with manufacturer's recommendations and as indicated.

3.2 FIELD QUALITY CONTROL

- .1 Perform tests in accordance with Section 26 05 00 – Common Work Results - Electrical and Section 01 91 13 – General Commissioning (Cx) Requirements.
- .2 Actuate control units in presence of Owner's Representative to demonstrate lighting circuits are controlled as designated.

END OF SECTION

1.0 GENERAL

1.1 RELATED DOCUMENTS

- .1 Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SECTION INCLUDES

- .1 Materials and components for dry type transformers up to 600 V primary, equipment identification and transformer installation.
- .2 This Section includes the following types of dry-type transformers rated 600 V and less, with capacities up to 1000 kVA:
 - .1 Distribution transformers.
 - .2 Buck-boost transformers.

1.3 RELATED SECTIONS

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

1.4 REFERENCES

- .1 Canadian Standards Association (CSA)
 - .1 CAN/CSA-C22.2 No.47, Air-Cooled Transformers (Dry Type).
 - .2 CSA C9, Dry-Type Transformers.
- .2 National Electrical Manufacturers Association (NEMA)

1.5 SUBMITTALS

- .1 Product Data for each type and size of transformer indicated.
 - .1 Physical: Include rated nameplate data, capacities, weights, dimensions, minimum clearances, installed devices and features.
 - .2 Product warranty.
 - .3 Details of contributions to LEED, including Energy & Atmosphere credits.
 - .1 Provide proposed energy savings in Annual kWh and Peak Demand kW compared to a NEMA TP-1 efficiency baseline for the transformers on the project.

- .4 Efficiency Data
 - .1 No load and full load losses per NEMA TP-1.
 - .2 Linear load Efficiency data @ 1/6, 1/4, 1/2, 3/4, & full load.
 - .3 Linear Load Efficiency @ 35% loading tested per NEMA TP-2.
 - .4 Efficiency under K7 load profile at 15%, 25%, 50%, 75%, 100% of nameplate rating.
- .2 Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 - .1 Wiring Diagrams: Power, signal, and control wiring.
- .3 Qualification Data: For testing agency.
- .4 Source quality-control test reports.
- .5 Field quality-control test reports.
- .6 Operation and Maintenance Data: For transformers to include in emergency, operation, and maintenance manuals.

1.6 QUALITY ASSURANCE

- .1 Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is a member company of the InterNational Electrical Testing Association or is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7.
 - .1 Testing Agency's Field Supervisor: Person currently certified by the InterNational Electrical Testing Association or the National Institute for Certification in Engineering Technologies to supervise on-site testing specified in Part 3.
- .2 Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7.
- .3 Source Limitations: Obtain each transformer type through one source from a single manufacturer.
- .4 Electrical Components, Devices and Accessories: Listed and labelled as defined in NFPA 70, Article 100, and to Canadian Electrical Code (CEC), by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.



- .5 Comply with IEEE C57.12.91, “Test Code for Dry-Type Distribution and Power Transformers.”
- .6 Comply with IEEE C57.110-1998-IEEE recommended practise for establishing transformer capability when feeding non-sinusoidal load currents.

1.7 DELIVERY, STORAGE, AND HANDLING

- .1 Temporary Heating: Apply temporary heat according to manufacturer’s written instructions within the enclosure of each ventilated-type unit, throughout periods during which equipment is not energized and when transformer is not in a space that is continuously under normal control of temperature and humidity.

1.8 COORDINATION

- .1 Coordinate size and location of concrete bases with actual transformer provided. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and form work requirements are specified in Division 03.
- .2 Coordinate installation of wall-mounting and structure-hanging supports with actual transformer provided.

2.0 PRODUCTS

2.1 GENERAL TRANSFORMER REQUIREMENTS

- .1 Description: Factory-assembled and tested, air-cooled units for 60 Hz service
- .2 Cores: Grain-oriented, non-aging silicon steel.
- .3 Coils: Continuous windings without splices except for taps.
 - .1 Internal Coil Connections: Brazed or pressure type.
 - .2 Coil Material: Copper.

2.2 DISTRIBUTION TRANSFORMERS

- .1 Provide a 25-year pro-rated product Warranty.
 - .2 Comply with NEMA ST 20, and list and label as complying with UL 1561.
 - .3 Cores: One leg per phase.
 - .4 Enclosure: Ventilated, NEMA 250, Type 2.
-



- .1 Core and coil shall be impregnated within resin compound, sealing out moisture and air.
 - .5 Transformer Enclosure Finish: Comply with NEMA 250.
 - .1 Finish Color: Manufacturer’s Standard.
 - .6 Taps for Transformers smaller than 3 kVA: None.
 - .7 Taps for Transformers 7.5 to 24 kVA: One 5 percent tap above and one 5 percent tap below normal full capacity.
 - .8 Taps for Transformers 25 kVA and larger: Two 2.5 percent taps above and four 2.0 percent taps below normal full capacity.
 - .9 Insulation Class: 220 deg C, UL-component-recognized insulation system with a maximum of 130 deg C rise above 40 deg C ambient temperature.
 - .10 Energy Efficiency for Transformers Rated 15 kVA and larger:
 - .1 Comply with 10 CFR Part 430, July 29, 2004, FEDERAL Register – US Department of Energy, Office of Energy Efficiency and Renewable Energy. Energy Conservation Program for Commercial and Industrial Equipment: Energy Conservation Standards for Distribution Transformers; Proposed Rule.
 - .2 Meet or exceed DOE 10 CFR Part 430 CSL3 Efficiency, tested per NEMA TP-2:
 - .1 15kVA: 97.6%
 - .2 30kVA: 98.1%
 - .3 45kVA: 98.3%
 - .4 75kVA: 98.6%
 - .5 112.5kVA: 98.8%
 - .6 150kVA: 98.9%
 - .7 225kVA: 98.9%
 - .8 300kVA: 99.0%
 - .9 500kVA: 99.1%
 - .10 750kVA: 99.2%
 - .11 K-Factor Rating: Transformers shall be K-Factor 7 or higher rated and comply with UL 1561 requirements for non-sinusoidal load current-handling capability to the degree defined by designated K-factor.
 - .1 Unit shall not overheat when carrying full-load current with harmonic distortion corresponding to designated K-factor.
 - .2 Indicate value of K-factor on transformer nameplate.
-

- .12 Electrostatic Shielding: Each winding shall have an independent, single, full-width copper electrostatic shield arranged to minimize inter-winding capacitance.
 - .1 Arrange coil leads and terminal strips to minimize capacitive coupling between input and output terminals.
 - .2 Include special terminal for grounding the shield.
 - .3 Shield Effectiveness:
 - .1 Capacitance between Primary and Secondary Windings: Not to exceed 33 picofarads over a frequency range of 20 Hz to 1 MHz.
 - .2 Common-Mode Noise Attenuation: Minimum of minus 120 dB at 0.5 to 1.5 kHz; minimum of minus 65 dB at 1.5 to 100 kHz.
 - .3 Normal-Mode Noise Attenuation: Minimum of minus 52 dB at 1.5 to 10 kHz.
- .13 Wall Brackets: Manufacturer's standard brackets.
- .14 Fungus Proofing: Permanent fungicidal treatment for coil and core.
- .15 Low-Sound-Level Requirements: NEMA ST 20 standard sound levels when factory tested according to IEEE C57.12.91.

2.3 OPTIONS TO ADDRESS NFPA 70E/CSA-Z462 ARC FLASH STANDARD

- .1 Integrated External Measurement Port
 - .1 Include external ports with 600V safety class twistlock connectors for quick and safe access to transformer primary and secondary voltages and currents with revenue 0.3 class accuracy. Accurate and dynamic temperature data shall be provided via thermistors located in each leg of the transformer.
- .2 Integrated Power/Energy/Power Quality Meter
 - .1 Basis of design: Equivalent or superior to Powersmiths SMART-3B.
 - .2 Meter shall be factory-installed on the transformer, connected to the transformer secondary, complete with fused voltage connections, revenue class 0.3 CTs individually characterized to 0.1% and CT shunting block.
 - .3 Provide local display of real time energy and power quality information as it related to the load fed from the transformer.
 - .4 Parameters measured include: V, I, THD (V, I), PF, Hz, kW, kVA, kVAR, kWh, Ad, KWd, kVAd, kVARd.
 - .5 Remote communications: Modbus TCP over Ethernet using built-in software for access via a standard web browser.



- .6 Education for Sustainability System Ready. Ensure that the integrated power meter specified above shall come complete with the necessary built-in connectivity including Ethernet/Modbus TCP and external IP capability to support a web-based building benchmarking and education for sustainability system that graphically illustrates the performance of the building relative to environmental and energy strategies including LEED. Refer to Section 27 54 01.
- .3 Integrated Infrared Inspection Window
 - .1 Allows Safe External Thermal Imaging of Fully Energized Electrical Components without removing the transformer cover.
 - .2 IP65/NEMA 4 rated both open and closed.
- .4 Lockable Hinged Front Access Doors
 - .1 Allows safe and rapid access to the transformer without the need to undo multiple screws and handle heavy metal cover plates that are in close proximity to live electrical points.
 - .2 Doors shall be able to be secured using a padlock.

2.4 IDENTIFICATION DEVICES

- .1 Nameplates: Engraved, laminated-plastic or metal nameplate for each distribution transformer, mounted with corrosion-resistant screws. Name-plated label products are specified in Division 26 Section “Identification for Electrical Systems”.

2.5 SOURCE QUALITY CONTROL

- .1 Test and inspect transformers according to IEEE C57.12.91.
- .2 Factory Sound-Level Tests: Conduct sound-level tests on equipment for this Project.

3.0 EXECUTION

3.1 EXAMINATION

- .1 Examine conditions for compliance with enclosure and ambient temperature requirements for each transformer.
 - .2 Verify that field measurements are as needed to maintain working clearances required by OESC latest edition and manufacturer’s written instructions.
 - .3 Examine walls, floors, roofs, and concrete bases for suitable mounting conditions where transformers will be installed.
-



- .4 Verify that ground connections are in place and requirements in Division 26 Section “Grounding and Bonding for Electrical System’s have been met. Maximum ground resistance shall be 5 ohms at location of transformer.
- .5 Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- .1 Install wall-mounting transformers level and plumb with wall brackets fabricated by transformer manufacturer.
 - .1 Brace wall-mounting transformers as specified in Division 26 Section “Vibration and seismic Controls for Electrical Systems”.
 - .2 Construct concrete bases and anchor floor-mounting transformers according to manufacturer’s written instructions, seismic codes applicable to Project, and requirements in Division 26 Section “Vibration and Seismic Controls for Electrical Systems”.
 - .3 Mount metering package on transformer enclosure.

3.3 CONNECTIONS

- .1 Ground equipment according to Division 26 Section “Grounding and Bonding for Electrical Systems”.
- .2 Connect wiring according to Division 26 Section “Low-Voltage Electrical Power Conductors and Cables”.

3.4 FIELD QUALITY CONTROL

- .1 Perform tests and inspections and prepare test reports.
 - .1 Manufacturer’s Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
 - .2 Tests and Inspections:
 - .1 Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
 - .2 Test transformers for losses and efficiency. Verify results are consistent with the loss data provided on the submittal documenting compliance with DOE CSL 3 class efficiency.
 - .3 Remove and replace units that do not pass tests or inspections and retest as specified above.



- .4 Infrared Scanning: Two months after Substantial Completion, perform an infrared scan of transformer connections.
 - .1 Use an infrared-scanning device designed to measure temperature or detect significant deviations from normal values. Provide documentation of device calibration.
 - .2 Perform 2 follow-up infrared scans of transformers, one at 4 months and the other at 11 months after Substantial Completion.
 - .3 Prepare a certified report identifying transformer checked and describing results of scanning. Include notation of deficiencies detected, remedial action taken, and scanning observations after remedial action.
- .5 Test Labelling: On completion of satisfactory testing of each unit, attach a dated and signed “Satisfactory Test” label to tested component.

3.5 ADJUSTING

- .1 Record transformer secondary voltage at each unit for at least 48 hours of typical occupancy period. Adjust transformer taps to provide optimum voltage conditions at secondary terminals. Optimum is defined as not exceeding name plate voltage plus 10 percent and not being lower than name plate voltage minus 3 percent at maximum load conditions. Submit recording and tap settings as test results.
- .2 Connect buck-boost transformers to provide name plate voltage of equipment being served, plus or minus 5 percent, at secondary terminals.
- .3 Output Settings Report: Prepare a written report recording output voltages and tap settings.

3.6 CLEANING

- .1 Vacuum dirt and debris; do not use compressed air to assist in cleaning.

END OF SECTION



1.0 GENERAL

1.1 SECTION INCLUDES

1. Switchboards.
2. Buses.
3. Circuit breakers.
4. Instruments, controls, and accessories.
5. Source quality control.

1.2 MEASUREMENT AND PAYMENT

1. General: Switchboards, as specified herein, will not be measured separately for payment but will be paid for as part of the Contract lump sum price for Electrical Work.

1.3 REFERENCES

1. American Society for Testing and Materials (ASTM):
 1. ASTM A653/A653M Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
2. California Code of Regulations (CCR):
 1. Title 24, Part 2 California Building Code
 2. Title 24, Part 3 California Electrical Code
3. Institute of Electrical and Electronics Engineers (IEEE):
 1. IEEE C37 Circuit Breakers, Switchgear, Substations, and Fuses.
 2. IEEE C57.13 IEEE Standard Requirements for Instrument Transformers
 3. IEEE C37.20.1 Standard for Metal-Enclosed Low-Voltage (1000 Vac and below, 3200 Vdc and below) Power Circuit Breaker Switchgear
 4. IEEE C37.13 Low-Voltage AC Power Circuit Breakers Used in Enclosures
 5. IEEE C37.17 Trip Systems for Low-Voltage (1000 V and below) AC and General Purpose (1500 V and below) DC Power Circuit Breakers



4. National Electrical Manufacturers Association (NEMA):
 1. NEMA PB 2 Deadfront Distribution Switchboards
5. Underwriters Laboratories Inc. (UL):
 1. UL 489 UL Standard for Safety Molded-Case Circuit Breakers, Molded- Case Switches and Circuit-Breaker Enclosures
 2. UL 891 UL Standard for Safety Switchboards
 3. UL 1066 UL Standard for Safety Low-Voltage AC and DC Power Circuit Breakers Used in Enclosures
6. National Fire Protection Association (NFPA):
 1. NFPA 70 National Electrical Code

1.4 SUBMITTALS

1. General: Refer to Section 01 33 00, Submittal Procedures, and Section 01 33 23, Shop Drawings, Product Data, and Samples, for submittal requirements and procedures.
 1. Refer to local utility electrical service requirement for service switchgear
2. Product Data: Submit manufacturer's product data for all manufactured materials and equipment. Submit certified reports of factory tests performed on each switchboard unit.
3. Shop Drawings: Submit detailed Shop Drawings as follows:
 1. Master Drawing Index
 2. Single line diagrams;
 3. Physical arrangement drawings, and weight of equipment and major components;
 4. Unit wiring diagrams;
 5. Drawings showing space available for conduit entrance and for routing and training of cables. Available space shall take into consideration bending radius requirements of cables;
 6. Schematic diagrams for electrically operated equipment;



7. Nameplates Schedule
 8. Component List
 9. Schematic diagrams and templates if anchoring in concrete is required.
 10. Setting diagrams and templates if anchoring in concrete is required;
 11. Assembly and erection diagrams if shipped in sections or if any parts are shipped separately and not installed at the factory; and
 12. Interconnection diagrams for circuits having externally located instruments, controls, alarms, or similar devices.
 13. Assembly rating including:
 - a. Short-circuit rating
 - b. Voltage
 - c. Continuous current rating
 14. Major component rating included:
 - a. Voltage
 - b. Continuous current rating c.
Interrupting rating
 15. Protective Device Time-Current Curves
4. Operation and Maintenance Data: Submit data in accordance with Section 01 78 23, Operation and Maintenance Data, including the following requirements:
1. Description of the switchboard and its components;
 2. Manufacturer's operating and maintenance instructions, parts list, illustrations, and diagram for components;
 3. Recommended list of spare parts;
 4. Wiring diagram;
 5. Electrical characteristics of each component including relays or solid state circuitry; and
 6. Relay coordination curves.
5. Field Test Reports: Submit certified field test reports verifying compliance with Specification requirements.



1.5 DELIVERY, STORAGE, AND HANDLING

1. Securely wrap, package, and label each unit for safe handling during shipment.
2. Brace and package the equipment for easy and safe handling. Clearly label temporary internal bracing of equipment as “Temporary Bracing: To Be Removed Before Operation.”
3. Use a mechanical impact recorder during shipment, capable of registering maximum acceleration. Submit impact record chart to the Engineer.
4. Store switchboard in secure and dry storage facility.

2.0 PRODUCTS

2.1 SWITCHBOARDS

1. Switchboard Requirements
 1. Furnish distribution switchboards that are completely metal enclosed, self supporting, dead front, freestanding, circuit-breaker type for indoor service, that comply with NEMA PB 2, the California Electrical Code, and that are UL listed in accordance with UL 891.
 2. Furnish the required number of vertical sections bolted together to form a rigid switchboard. Furnish the number, type, and ratings of circuit breakers and protective devices as indicated.
 3. Furnish switchboards completely assembled, wired, and tested at the manufacturer’s plant. If approved by the Engineer, switchboards may be broken down into convenient shipping sections subsequent to the completion of the tests. Separate shipping split terminals shall be provided and connections disconnected for shipping shall be properly identified and protected.
 4. Switchboards in the same line up fed electrically from different feeders shall have barriers such that a fire caused by an internal fault at one switchboard shall not spread to another switchboard.
2. Ratings: Furnish completed switchboards rated for service on 600 V, three- phase, four-wire power systems. Symmetrical short circuit current ratings, breaker frame sizes, number of poles, trip unit characteristics, instrument ratings, instrument transformer ratings, and control equipment ratings shall be as indicated. Switchboard current ratings shall be based on operations in a 25 degrees C room ambient.
3. Physical Size: Furnish switchboards 90 inches high, and of width and depth adequate to accommodate and connect the equipment. Vertical sections shall be aligned front and rear, and shall be equipped with rear doors.



2.2 BUSES

1. Requirements: Provide silver-plated copper buses of sufficient size to limit the current density to 750 A per square inch cross-section. Brace distribution switchboard buses for the symmetrical fault current indicated.
2. Main Buses: Extend main buses horizontally from the incoming line sections to all distribution sections if indicated on the same line up. Make provision for extending the main buses for future vertical sections. Neutral bus shall be fully rated, and shall be carried by a neutral pole in the automatic transfer switch.
3. Section Buses: Extend section buses vertically from the main bus through each vertical section.
4. Ground Buses: Extend a ground bus through the length of the switchboard and firmly bolt to each vertical section in at least two places. Make provision for connection to the building or station grounding system near each end of the ground bus. Make provision for future extension of the ground bus.
5. Phasing: Phase buses A B C from left to right, top to bottom, and front to rear as viewed from the front of the switchboard.
6. Bus Connections: Bus connections shall be made only by means of machine screws into threaded holes or with through-bolts with washers and nuts. Connections shall be provided with lock washers for mechanical locking.

2.3 CIRCUIT BREAKERS

1. Provide circuit breakers of the draw out mounted, stored energy, electrically operated type, 600 V, three-phase, 60 Hz, in accordance with NEMA PB 2 and UL 891, with the following additional requirements:
 1. Rated continuous current: As indicated.
 - a. Symmetrical interrupting rating: As indicated.
 - b. Maximum of five cycle closing time.
 2. Breakers shall be equipped with solid state trip unit with voltage and current sensors as indicated, and as required. and a minimum of seven time/current systems coordination adjustment, including ground fault and under-voltage settings.
 3. Insulation rating of plug shall be the same as the breaker rating.
 4. Circuit breakers shall be capable of performing 4000 close open cycles at rated load, 80 percent power factor and rated voltage, and 4000 close open cycles at no load without maintenance and replacement of parts.
 5. Breakers shall have control power and motor charging device of 120 V ac.



6. Breakers shall be equipped with field replaceable contacts.
2. Molded-Case Circuit Breakers
 1. Molded-Case type circuit breakers shall be mechanically operated with over-center toggle.
 - a. Rated continuous current: As indicated and as required.
 - b. Symmetrical interrupting rating; As indicated, and as required.
 - c. Maximum of five cycle closing time.
 2. Breakers shall be equipped with a solid-state trip with voltage and current sensors as indicated and as required and time/current system coordination adjustment, including ground fault and under-voltage setting.
 3. Insulation rating of plug shall be the same as the breaker rating.
 4. Breakers have control power and motor charging device of 120V ac.

2.4 INSTRUMENTS, CONTROLS, AND ACCESSORIES

1. Potential Transformers: IEEE C57.13, wound type with polarity markers, suitable for operating meters and relays, with the following additional requirements:
 1. Voltage ratio: 600 V primary to 120 V secondary.
 2. Insulation class: 600 V with basic impulse insulation level of 10 kV full wave.
 3. Temperature Rise: Maximum allowable temperature rise shall not exceed 55 degrees Celsius under continuous full load above an average ambient temperature of 25 degrees Celsius.
 - a. By winding resistance: 30 degrees Celsius.
 - b. By hottest spot in winding: 40 degrees Celsius.
2. Current Transformers:
 1. Provide current transformers in a separate compartment isolated from the meter section. Provide metallic shielding to protect current transformers and secondary wiring from induced voltages and to minimize the possibility of insulation failure.
 2. Current Transformers shall be bushing or epoxy encapsulated wound type. Secondary terminal blocks shall have covers with integral shorting bars. Secondary wiring shall be connected to readily identifiable terminal block points in the control compartment. Terminal block points shall have integral shorting bars for the current transformer leads.
 3. Provide current transformers capable of withstanding thermal and magnetic stresses from the flow of the interrupting and momentary currents of the circuit breakers. Current transformers shall have a mounting frame bolted securely to the switchgear.



frame. Current transformers shall comply with IEEE C57.13 requirements for relaying accuracy classification under the burdens imposed by the devices specified or implied herein.

3. Meters:
 1. Type: IEC 60051, square, taut band, transformer rated, ironvane.
 2. Dial: Approximately 4-1/2 inches square, graduated from zero to full range with black figures on white background.
 3. Voltmeter rating: 600 V. Ammeter rating: 125 percent of circuit rating, or as indicated.
 4. Accuracy Class: One percent of full scale.
4. Relays:
 1. Provide one lock out relay for preventing the breaker to re-close after abnormal conditions, except under-voltage.
 2. Provide one time delay relay, adjustable from 0 to 6 seconds, for use with under- voltage relay.
5. Control Switches:
 1. Provide control switch as required and indicated.
 2. Provide relay test switch.
 3. Provide manual pushbutton at the front of breaker housing for testing breaker.
6. Control and Instrument Wiring: Provide factory-installed wiring in accordance with the following requirements:
 1. Wire: Provide type SIS tinned copper wire not smaller than 14 AWG. Class D stranded wire, not smaller than 12 AWG, shall be used for wiring across hinged joints.
 2. Wire Terminals: Tinned copper ring compression terminals with insulated sleeve installed in accordance with the manufacturer's requirements.
 3. Terminal Blocks: Provide washerhead screws suitable for ring compression terminals with insulated sleeve. Provide a minimum of 10 percent spare terminals.
 4. Position Switch and Auxiliary Contacts: Provide position switch and breaker auxiliary contacts as indicated.
 5. Wire Connections: Controls, relays, and metering circuit terminals requiring external connections shall be wired to accessible terminal blocks. Interconnecting wires terminated on terminal blocks shall be provided in each cubicle.



6. Wire Identification: Each wire shall be provided with plastic strip, attached adjacent to terminal connection, marked with the number indicated on the wiring diagrams, and positioned with the label facing out for ease of identification.
7. Fuses: Provide current limiting fuse in each control circuit.
8. Enclosure: Freestanding type, designed for group assembly to be part of complete indoor ac distribution, with the following additional requirements:
 1. Enclosure shall be reinforced with adequate steel framework to form a rigid structure with a smooth outer surface free from burrs, ridges, and other blemishes.
 2. Enclosure shall be fabricated from zinc coated steel sheet conforming to ASTM A653/A653M, zinc coating designation G90.
 3. Enclosure metallic surfaces shall be thoroughly cleaned, degreased, treated with hot phosphate chemical bath, primed with corrosion inhibiting undercoat primer, and painted with finish coat of heavy-duty, industrial-grade, polyurethane enamel, in standard color as selected by the Engineer.
9. Nameplates: Provide nameplates on each switchboard assembly, individual cabinets, and internal components including relays, switches, lights, and other devices.

2.5 SOURCE QUALITY CONTROL

1. In addition to the manufacturer's standard tests, as a minimum perform the following tests at the manufacturer's plant:
 1. 60 Hz dielectric tests;
 2. Mechanical operations tests;
 3. Grounding of instruments;
 4. Transformer case tests;
 5. Electrical operation tests; and
 6. Control wiring checks.

3.0 EXECUTION

3.1 INSTALLATION REQUIREMENTS

1. Install, wire, and connect switchboards ready for operation in accordance with these Specifications, the manufacturer's installation instructions, and as indicated.

3.2 WIRING AND CONDUIT WORK



1. Refer to Section 26 05 21, Low Voltage Wires and Cables.

3.3 GROUNDING

1. Refer to Section 26 05 28, Grounding and Bonding for Electrical Systems.

3.4 SWITCHBOARD INSTALLATION

1. Install switchboards in the locations indicated, secure, plumb and level, and align with related adjoining work. The switchboard anchorage and installation shall conform with California Building Code seismic-restraint requirements. Install switchboard on a 4-inch-high concrete pad with leveling channels.
2. Provide anchor bolts and anchorage items as required, and field check to ensure proper alignment and location. Provide templates, layout drawings, and supervision at the jobsite to ensure correct placing of anchorage items in concrete. Check embedded items for correctness of location and detail before concrete is placed.
3. Install supporting members, fastenings, framing, hangers, bracing, brackets, straps, bolts, and angles as required to set and rigidly connect the switchboard.
4. Provide temporary bracing, guys, or other devices as required to accomplish erection and to provide safety and stability until work is in final position and approved.
5. Control erection tolerance requirements so as not to impair the strength, safety, serviceability, and appearance.
6. Exercise special care during construction to avoid overloading any part of the structure. Repair or replace items damaged due to overloading.

3.5 FIELD TOUCH-UP PAINTING

1. After installations are complete, thoroughly clean surfaces where shop paint coating is missing or abraded bare steel, including bolts, nuts, washers and welds, and paint each item with the same paint system as used for shop painting. Provide touch-up painting by approved spray methods or brush where spray-painting is not practical.

3.6 FIELD TESTS

1. Provide equipment for testing power, lighting, and control circuits after installation, including service test kit. Test under the observation of the Engineer, and demonstrate the following attributes:
 1. Verify that circuits are connected in accordance with the applicable wiring diagrams.
 2. Verify that circuits are continuous and free from short circuits.



3. Verify that the insulation resistance to ground of non-grounded conductors is megger tested to not less than 10 M Ω .
4. Verify that the completed equipment grounding system is megger tested at each service disconnect enclosure ground bar to ensure connection to ground.
5. Verify that circuits are operable. Conduct tests to include operating each control not less than ten times, and the continuous operation of each lighting and power circuit for not less than 1/2 hour.

END OF SECTION

1.0 GENERAL

1.1 SECTION INCLUDES

- .1 Materials and installation for standard and custom breaker type panelboards.

1.2 RELATED SECTIONS

- .1 Section 01 33 00 - Submittal Procedures.
- .2 Section 06 10 53 – Miscellaneous Rough Carpentry.
- .3 Section 26 05 00 – Common Work Results - Electrical.
- .4 Section 26 28 16.02 - Moulded Case Circuit Breakers.

1.3 REFERENCES

- .1 Canadian Standards Association (CSA)
 - .1 CSA C22.2 No.29, Panelboards and enclosed Panelboards.

1.4 SHOP DRAWINGS

- .1 Submit shop drawings in accordance with Section 01 33 00 – Shop Drawing Submittals.
- .5 Drawings to include electrical detail of panel, branch breaker type, quantity, ampacity and enclosure dimension.

1.5 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate and recycle waste materials in accordance with Section 01 74 19 – Construction / Demolition Waste Management and Disposal.
- .2 Remove from site and dispose of all packaging materials at appropriate recycling facilities.
- .3 Collect and separate for disposal packaging material for recycling in accordance with Waste Management Plan.
- .4 Divert unused metal materials from landfill to metal recycling facility as approved by Consultant.
- .5 Fold up metal banding, flatten and place in designated area for recycling.

2.0 PRODUCTS

2.1 PANELBOARDS

- .1 Panelboards: to CSA C22.2 No.29 and product of one manufacturer.
 - .1 Install circuit breakers in panelboards before shipment.
 - .2 In addition to CSA requirements manufacturer's nameplate must show fault current that panel including breakers has been built to withstand.
- .2 250 and 600 V panelboards: bus and breakers rated for 10,000 and 18,000 A (symmetrical) minimum interrupting capacity respectively or as indicated on electrical drawings.
- .3 Sequence phase bussing with odd numbered breakers on left and even on right, with each breaker identified by permanent number identification as to circuit number and phase.
- .4 Panelboards: mains, number of circuits, and number and size of branch circuit breakers as indicated.
- .5 Two keys for each panelboard and key panelboards alike.
- .6 Tin plated aluminum bus with neutral of same ampere rating as mains.
- .7 Mains: suitable for bolt-on breakers.
- .8 Trim with concealed front bolts and hinges.
- .9 Trim and door finish: baked grey enamel.

2.2 CUSTOM BUILT PANELBOARD ASSEMBLIES

- .1 125 mm relay section on one or both sides of panels as indicated for installation of low voltage remote control switching components.
- .2 Double stack panels as indicated.
- .3 Contactors in mains as indicated.
- .4 Feed through lugs as indicated.

2.3 BREAKERS

- .1 Breakers: to Section 26 28 16.02 - Moulded Case Circuit Breakers.
- .2 Breakers with thermal and magnetic tripping in panelboards except as indicated otherwise.

- .3 Main breaker: separately mounted on top or bottom of panel to suit cable entry. When mounted vertically, down position should open breaker.
- .4 Lock-on devices for 10% of 15 to 30 A breakers installed as indicated. Turn over unused lock-on devices to Departmental Representative.
- .5 Lock-on devices for receptacles, fire alarm clock outlet, emergency, door supervisory, intercom, stairway, exit and night light circuits as indicated.

2.4 EQUIPMENT IDENTIFICATION

- .1 Provide equipment identification in accordance with Section 26 05 00 – Common Work Results - Electrical.
- .2 Nameplate for each panelboard size 4 engraved as indicated.
- .3 Nameplate for each circuit in distribution panelboards size 2 engraved as indicated.
- .4 Complete circuit directory with typewritten legend showing location and load of each circuit.

3.0 EXECUTION

3.1 INSTALLATION

- .1 Locate panelboards as indicated and mount securely, plumb, true and square, to adjoining surfaces.
- .2 Install surface mounted panelboards on plywood backboards in accordance with Section 06 10 00 - Rough Carpentry. Where practical, group panelboards on common backboard.
- .3 Mount panelboards to height specified in Section 26 05 00 – Common Work Results - Electrical or as indicated.
- .4 Connect loads to circuits.
- .5 Connect neutral conductors to common neutral bus with respective neutral identified.

END OF SECTION

1.0 GENERAL

1.1 RELATED SECTIONS

- .1 Submit in accordance with Section 01 33 00 - Submittals.

1.2 REFERENCES

- .1 The Munsell System of Colour Notation.

1.3 SHOP DRAWINGS

- .1 Submit in accordance with Section 01 33 00 - Submittals.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for electrical cabinets and enclosures and include product characteristics, performance criteria, physical size, finish and limitations.

1.4 CLOSEOUT SUBMITTALS

- .1 Submit in accordance with Section 01 77 00 - Closeout Procedures.
- .2 Operation and Maintenance Data: submit operation and maintenance data for electrical cabinets and enclosures for incorporation into manual.

1.5 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 60 00 – Products and workmanship, with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store materials indoors and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect electrical cabinets and enclosures from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.

1.6 QUALITY ASSURANCE

- .1 Products of This Section: Manufactured to ISO 14000, ISO 9000 and certification requirements.
- .2 Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum five (5) years documented experience.

1.7 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate and recycle waste materials in accordance with Section 01 74 19 – Construction / Demolition Waste Management and Disposal.
- .2 Remove from site and dispose of all packaging materials at appropriate recycling facilities.
- .3 Collect and separate for disposal packaging material for recycling in accordance with Waste Management Plan.
- .4 Divert unused metal materials from landfill to metal recycling facility as approved by Consultant.
- .5 Fold up metal banding, flatten and place in designated area for recycling.

2.0 PRODUCTS

2.1 MATERIALS

- .1 Enclosure constructed with 2.7 mm thick minimum steel, with weather and corrosion resistant finish to CAN/CSA C22.2, Munsell Notation 7.5GY3.5/1.5, size as indicated.
- .2 Entire enclosure to be capable of withstanding maximum impact force of 86 MN/m² area without rupture of material.
- .3 Removable enclosure panels with formed edges, galvanized steel external fasteners removable only from inside enclosure.
- .4 Equip enclosure with hot dipped galvanized mounting rails, as required, adjustable horizontally and vertically to enable mounting of equipment at any location within housing.
 - .1 Rails: 14 mm holes and 50 x 14 mm slots on 100 mm centres for horizontal adjustment.
 - .2 Holes in side panel flanges in 60 mm increments for vertical adjustment.
- .5 Cover: tamperproof, bolt-on, domed to shed water.
- .6 Door: 3 point latching, with padlocking means.

- .7 Ventilation panel constructed to allow air circulation yet preventing entry of foreign objects, wild life, and vermin.
- .8 Door interlocks: As indicated, or as required.
- .9 Enclosure construction such as to allow configuration of single or ganged enclosures.
- .10 Enclosure capable of being shipped in knocked-down condition.

3.0 EXECUTION

3.1 EXAMINATION

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

3.2 INSTALLATION

- .1 Assemble enclosure in accordance with manufacturer's instructions and securely mount on building structure with channels, supports and fastenings.
- .2 Mount equipment in enclosure.
- .3 Label electrical cabinets and enclosure to Section 26 05 00 - Common Work Results for Electrical.

3.3 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 13 – Progressive Cleaning.
 - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 13 – Progressive Cleaning.
 - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.



END OF SECTION

1.0 GENERAL

1.1 RELATED SECTIONS

- .1 Section 01 33 00 – Submittal Procedures.
- .2 Section 26 27 26 - Wiring Devices.

1.2 SUBMITTALS

- .1 Submit product data in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Indicate type of multi-outlet assemblies with similar terminology to these documents.

1.3 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate and recycle waste materials in accordance with Section 01 74 19 – Construction / Demolition Waste Management and Disposal.
- .2 Remove from site and dispose of all packaging materials at appropriate recycling facilities.
- .3 Collect and separate for disposal packaging material for recycling in accordance with Waste Management Plan.
- .4 Divert unused metal materials from landfill to metal recycling facility as approved by Consultant.
- .5 Fold up metal banding, flatten and place in designated area for recycling.

2.0 PRODUCTS

2.1 SURFACE RACEWAY FOR WIRING DEVICES

- .1 Two piece assembly manufactured for mounting wiring devices and associated wiring.
- .2 Cross-section dimensions: as indicated.
- .3 Finish: buff enamel.

2.2 WIRING DEVICES

- .1 Wiring devices: as indicated, to Section 26 27 26 - Wiring Devices.

2.3 PREWIRED RECEPTACLE HARNESS

- .1 Receptacle harness factory assembled with duplex receptacles at 1525 mm centres on 1 circuit.

2.4 GROUNDING

- .1 Ground system through separate insulated conductor.

2.5 VINYL PLASTIC STRIP

- .1 Extruded rigid vinyl plastic with 2- No.12 AWG copper wires and continuous ground strip.
- .2 Unfused "U" ground lock-in receptacle for each 1.5 m of strip as indicated.

2.6 FITTINGS

- .1 Elbows, tees, couplings, hanger fittings and other fittings providing directional or dimensional changes manufactured as accessories to product line supplied.

3.0 EXECUTION

3.1 FITTINGS

- .1 Install supports, elbows, tees, connectors, fittings.
- .2 Keep number of elbows, offsets and connections to minimum.
- .3 Install barriers where required.

3.2 WIRING

- .1 Install wiring as indicated Install receptacle harness.

3.3 VINYL STRIP RECEPTACLES

- .1 Install receptacles.

END OF SECTION

1.0 GENERAL

1.1 SECTION INCLUDES

- .1 Switches, receptacles, wiring devices, cover plates and their installation.

1.2 RELATED SECTIONS

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

1.3 REFERENCES

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

1.4 SHOP DRAWINGS AND PRODUCT DATA

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

1.5 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate and recycle waste materials in accordance with Section 01 74 19 – Construction / Demolition Waste Management and Disposal.
- .2 Remove from site and dispose of all packaging materials at appropriate recycling facilities.
- .3 Collect and separate for disposal packaging material for recycling in accordance with Waste Management Plan.
- .4 Divert unused metal materials from landfill to metal recycling facility as approved by Consultant.
- .5 Fold up metal banding, flatten and place in designated area for recycling.

2.0 PRODUCTS

2.1 SWITCHES

- .1 15 A, 120 V, single pole, double pole, three-way, four-way switches as indicated to: CSA-C22.2 No.55 and CSA-C22.2 No.111.
- .2 Manually-operated general purpose ac switches with following features:
 - .1 Terminal holes approved for No. 10 AWG wire.
 - .2 Silver alloy contacts.
 - .3 Urea or melamine moulding for parts subject to carbon tracking.
 - .4 Suitable for back and side wiring.
 - .5 Black finish, or as otherwise specified by project architect, or to match existing conditions.
 - .6 Specification grade.
- .3 Toggle operated fully rated for tungsten filament and fluorescent lamps, and up to 80% of rated capacity of motor loads.
- .4 Switches of one manufacturer throughout project.

2.2 RECEPTACLES

- .1 Duplex receptacles, CSA type 5-15 R, 125 V, 15 A, U ground, to: CSA-C22.2 No.42 with following features:
 - .1 Ivory thermoplastic moulded housing.
 - .2 Suitable for No. 10 AWG for back and side wiring.
 - .3 Break-off links for use as split receptacles.
 - .4 Eight back wired entrances, four side wiring screws.
 - .5 Triple wipe contacts and rivetted grounding contacts.
 - .6 Specification grade.
- .2 Single receptacles CSA type 5-15 R, 125 V, 15 A, U ground with following features:

- .1 Black finish, or as otherwise specified by project architect, or to match existing conditions, with thermoplastic moulded housing.
- .2 Suitable for No. 10 AWG for back and side wiring.
- .3 Four back wired entrances, 2 side wiring screws.
- .3 Other receptacles with ampacity and voltage as indicated.
- .4 Receptacles of one manufacturer throughout project.

2.3 SPECIAL WIRING DEVICES

- .1 Special wiring devices:
 - .1 Pilot lights as indicated, with neon type 0.04 W, 125 V lamp and red plastic jewel lense, flush type.

2.4 WIRING DEVICES FOR COMPUTER ROOMS

- .1 As indicated.

2.5 COVER PLATES

- .1 Cover plates for wiring devices to: CSA-C22.2 No.42.1.
- .2 Cover plates from one manufacturer throughout project.
- .3 Sheet steel utility box cover for wiring devices installed in surface-mounted utility boxes.
- .4 Stainless steel cover plates as indicated, thickness 2.5 mm for wiring devices mounted in flush-mounted outlet box.
- .5 Sheet metal cover plates for wiring devices mounted in surface-mounted FS or FD type conduit boxes.
- .6 Weatherproof cover plates complete with gaskets and “heavy-duty in use” covers in conformance with ESA.
- .7 Weatherproof spring-loaded cast aluminum cover plates complete with gaskets for single receptacles or switches.
- .8 All wiring device cover plates to be labeled using clear adhesive strips with black type identifying panel and circuit number for each device.

3.0 EXECUTION

3.1 INSTALLATION

- .1 Switches:
 - .1 Install single throw switches with handle in "UP" position when switch closed.
 - .2 Install switches in gang type outlet box when more than one switch is required in one location.
 - .3 Mount toggle switches at height in accordance with Section 26 05 00 – Common Work Results - Electrical.
- .2 Receptacles:
 - .1 Install receptacles in gang type outlet box when more than one receptacle is required in one location.
 - .2 Mount receptacles at height in accordance with Section 26 05 00 – Common Work Results - Electrical.
 - .3 Where split receptacle has one portion switched, mount vertically and switch upper portion.
- .3 Cover plates:
 - .1 Protect cover plate finish with paper or plastic film until painting and other work is finished.
 - .2 Install suitable common cover plates where wiring devices are grouped.
 - .3 Do not use cover plates meant for flush outlet boxes on surface-mounted boxes.

END OF SECTION

1.0 GENERAL

1.1 RELATED SECTIONS

- .1 Section 01 78 00 – Closeout Submittals.
- .2 Section 26 05 00 – Common Work Results - Electrical.

1.2 REFERENCES

- .1 Canadian Standards Association (CSA)
 - .1 CSA C22.2No.248.12, Low Voltage Fuses Part 12: Class R (Bi-National Standard with, UL 248-12 (1st Edition).

1.3 SUBMITTALS

- .1 Submit fuse performance data characteristics for each fuse type and size above 600 A. Performance data to include: average melting time-current characteristics.

1.4 DELIVERY AND STORAGE

- .1 Ship fuses in original containers.
- .2 Do not ship fuses installed in switchboard.
- .3 Store fuses in original containers in storage cabinet moisture free location.

1.5 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate and recycle waste materials in accordance with Section 01 74 19 – Construction / Demolition Waste Management and Disposal.
- .2 Remove from site and dispose of all packaging materials at appropriate recycling facilities.
- .3 Collect and separate for disposal packaging material for recycling in accordance with Waste Management Plan.
- .4 Divert unused metal materials from landfill to metal recycling facility as approved by Consultant.
- .5 Fold up metal banding, flatten and place in designated area for recycling.

2.0 PRODUCTS

2.1 FUSES GENERAL

- .1 Fuse type references L1, L2, J1, R1, etc. have been adopted for use in this specification.
- .2 Fuses: product of one manufacturer for entire project.

2.2 FUSE TYPES

- .1 Class L fuses (formerly HRC-L).
 - .1 Type L1, time delay, capable of carrying 500% of its rated current for 10 s minimum.
 - .2 Type L2, fast acting.
- .2 Class J fuses (formerly HRCI- J).
 - .1 Type J1, time delay, capable of carrying 500% of its rated current for 10 s minimum.
 - .2 Type J2, fast acting.
- .3 Class R -R fuses (formerly HRCI- R). For UL Class RK1 fuses, peak let-through current and its' peak let-through values not to exceed limits of UL 198E-1982, table 10.2.
 - .1 Type R1, (UL Class RK1), time delay, capable of carrying 500% of its rated current for 10 s minimum, to meet UL Class RK1 maximum let-through limits.
 - .2 Type R2, time delay, capable of carrying 500% of its rated current for 10 s minimum.
 - .3 Type R3, (UL Class RK1), fast acting Class R, to meet UL Class RK1 maximum let-through limits.
- .4 Class -C fuses (formerly HRCII- C).

3.0 EXECUTION

3.1 INSTALLATION

- .1 Install fuses in mounting devices immediately before energizing circuit. Ensure correct fuses fitted to physically matched mounting devices.
 - .1 Install Class R rejection clips for HRCI-R fuses.
- .2 Ensure correct fuses fitted to assigned electrical circuit.
- .3 Where UL Class RK1 fuses are specified, install warning label "Use only UL Class RK1 fuses for replacement" on equipment.
- .4 Install spare fuses in fuse storage cabinet.



END OF SECTION

1.0 GENERAL

1.1 RELATED SECTIONS

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

1.2 REFERENCES

- .1 Canadian Standards Association (CSA International).
 - .1 CSA-C22.2 No. 5-02, Moulded-Case Circuit Breakers, Molded-Case Switches and Circuit-Breaker Enclosures (Tri-national standard with UL 489, tenth edition, and the second edition of NMX-J-266-ANCE).

1.3 SUBMITTALS

- .1 Submit product data in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Include time-current characteristic curves for breakers with ampacity of 600 A and over or with interrupting capacity of 22,000 A symmetrical (rms) and over at system voltage.

1.4 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate and recycle waste materials in accordance with Section 01 74 19 – Construction / Demolition Waste Management and Disposal.
- .2 Remove from site and dispose of all packaging materials at appropriate recycling facilities.
- .3 Collect and separate for disposal packaging material for recycling in accordance with Waste Management Plan.
- .4 Divert unused metal materials from landfill to metal recycling facility as approved by Consultant.
- .5 Fold up metal banding, flatten and place in designated area for recycling.

2.0 PRODUCTS

2.1 BREAKERS GENERAL

- .1 Bolt-on moulded case circuit breaker: quick- make, quick-break type, for manual and automatic operation with temperature compensation for 40°C ambient.
- .2 Common-trip breakers: with single handle for multi-pole applications.

- .3 Magnetic instantaneous trip elements in circuit breakers to operate only when value of current reaches setting. Trip settings on breakers with adjustable trips to range from 3-8 times current rating.
- .4 Circuit breakers with interchangeable trips as indicated.
- .5 Circuit breakers to have minimum of 10,000 A symmetrical rms interrupting capacity rating at 208V and 14,000 A at 600V.

2.2 THERMAL MAGNETIC BREAKERS

- .1 Moulded case circuit breaker to operate automatically by means of thermal and magnetic tripping devices to provide inverse time current tripping and instantaneous tripping for short circuit protection.

2.3 FUSED THERMAL MAGNETIC BREAKERS

- .1 Fused thermal magnetic breakers with current limiting fuses internally mounted. Time current limiting characteristics of fuses coordinated with time current tripping characteristics of circuit breaker. Coordination to result in interruption by breaker of fault-level currents up to interrupting capacity of breaker. Fuses individually removable and interlocked with breaker. Removal of fuse cover, blowing of a fuse or removal of a fuse, to trip breaker.

2.4 SOLID STATE TRIP BREAKERS

- .1 Moulded case circuit breaker to operate by means of a solid-state trip unit with associated current monitors and self-powered shunt trip to provide inverse time current trip under overload condition, and long time short time, instantaneous tripping for phase and ground fault short circuit protection.

2.5 OPTIONAL FEATURES

- .1 Include:
 - .1 shunt trip.
 - .2 auxiliary switch.
 - .3 motor-operated mechanism c/w time delay unit.
 - .4 under-voltage release.
 - .5 on-off locking device.
 - .6 handle mechanism.



2.6 ENCLOSURE

- .1 Mounted in NEMA 1 type enclosure, sprinkler proof as indicated.

3.0 EXECUTION

3.1 INSTALLATION

- .1 Install circuit breakers as indicated.

END OF SECTION

1.0 GENERAL

1.1 RELATED SECTIONS

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

1.2 REFERENCES

- .1 Canadian Standards Association (CSA International).
 - .1 CAN/CSA C22.2 No.4, Enclosed Switches.
 - .2 CSA C22.2 No.39, Fuseholder Assemblies.

1.3 SUBMITTALS

- .1 Include time-current characteristic curves for breakers with ampacity of 600 A and over or with interrupting capacity of 22,000 A symmetrical (rms) and over at system voltage.

1.4 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate and recycle waste materials in accordance with Section 01 74 19 – Construction / Demolition Waste Management and Disposal.
- .2 Remove from site and dispose of all packaging materials at appropriate recycling facilities.
- .3 Collect and separate for disposal packaging material for recycling in accordance with Waste Management Plan.
- .4 Divert unused metal materials from landfill to metal recycling facility as approved by Consultant.
- .5 Fold up metal banding, flatten and place in designated area for recycling.

2.0 PRODUCTS

2.1 DISCONNECT SWITCHES

- .1 Fusible and non-fusible, disconnect switch in CSA Enclosure type 1, size as indicated.
 - .2 Provision for padlocking in on-off switch position by three locks.
 - .3 Mechanically interlocked door to prevent opening when handle in ON position.
-

- .4 Fuses: size as indicated, to Section 26 28 13.01 - Fuses - Low Voltage.
- .5 Fuseholders: 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 - Electrical.
- .2 Indicate name of load controlled on size 4 nameplate.

3.0 EXECUTION

3.1 INSTALLATION

- .1 Install disconnect switches complete with fuses as indicated.

END OF SECTION

1.0 GENERAL

1.1 SECTION INCLUDES

- .1 Materials and installation for contactors for system voltages up to 600 V.

1.2 RELATED SECTIONS

- .1 Section 01 33 00 - Submittal Procedures.
- .2 Section 26 05 00 – Common Work Results - Electrical.
- .4 Section 26 29 03 - Control Devices.

1.3 REFERENCES

- .1 Canadian Standards Association (CSA)
 - .1 CSA C22.2 No.14, Industrial Control Equipment.

1.4 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate and recycle waste materials in accordance with Section 01 74 19 – Construction / Demolition Waste Management and Disposal.
- .2 Remove from site and dispose of all packaging materials at appropriate recycling facilities.
- .3 Collect and separate for disposal packaging material for recycling in accordance with Waste Management Plan.
- .4 Divert unused metal materials from landfill to metal recycling facility as approved by Consultant.
- .5 Fold up metal banding, flatten and place in designated area for recycling.

2.0 PRODUCTS

2.1 CONTACTORS

- .1 Contactors: to CSA C22.2 No.14.
- .2 Electrically held controlled by pilot devices as indicated and rated for type of load controlled. Half size contactors not accepted.
- .3 Fused switch combination contactor as indicated.

- .4 Complete with 2 normally open and 2 normally closed auxiliary contacts unless indicated otherwise.
- .5 Mount in CSA Enclosure 1 unless otherwise indicated.
- .6 Include following options in cover:
 - .1 Red indicating lamp.
 - .2 Hand-Off-Auto selector switch.
- .7 Control transformer: in accordance with Section 26 29 03 - Control Devices, in contactor enclosure.

2.2 EQUIPMENT IDENTIFICATION

- .1 Provide equipment identification in accordance with Section 26 05 00 – Common Work Results - Electrical.
- .2 Size 4 nameplate indicating name of load controlled as indicated.

3.0 EXECUTION

3.1 INSTALLATION

- .1 Install contactors and connect auxiliary control devices.

END OF SECTION

1.0 GENERAL

1.1 REFERENCES

- .1 American National Standards Institute (ANSI)
 - .1 ANSI C82.1, Electric Lamp Ballasts-Line Frequency Fluorescent Lamp Ballast.
 - .2 ANSI C82.4, Ballasts for High-Intensity-Discharge and Low-Pressure Sodium Lamps.
- .2 American National Standards Institute/Institute of Electrical and Electronics Engineers (ANSI/IEEE)
 - .1 ANSI/IEEE C62.41, Surge Voltages in Low-Voltage AC Power Circuits.
- .3 American Society for Testing and Materials (ASTM)
 - .1 ASTM F1137, Specification for Phosphate/Oil and Phosphate/Organic Corrosion Protective Coatings for Fasteners.
- .4 United States of America, Federal Communications Commission (FCC)
 - .1 FCC (CFR47) EM and RF Interference Suppression.

1.2 RELATED SECTIONS

- .1 Section 01 33 00 - Submittal Procedures.
- .2 Section 01 45 00 - Quality Control.

1.3 SUBMITTALS

- .1 Submit complete photometric data prepared by independent testing laboratory for luminaires where specified, for review by Owner's Representative.
- .2 Photometric data to include: VCP Table and spacing criterion and luminaire coefficient of utilization (CU) tables.
- .3 Provide manufacturer's printed product literature, specifications and datasheet and include product characteristics, performance criteria, physical size, finish and limitations.
- .4 Quality assurance submittals: provide the following in accordance with Section 01 45 00 - Quality Control.

- .1 Manufacturer's instructions: provide manufacturer's written installation instructions and special handling criteria, installation sequence, cleaning procedures and relamping schedule.
- .5 Submit product literature for each type of lamp supplied, complete with the mercury content of each lamp.

1.4 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements.
- .2 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.
- .3 Divert unused metal materials from landfill to metal recycling facility.
- .4 Disposal and recycling of fluorescent lamps as per local regulations.
- .5 Disposal of old PCB filled ballasts.

1.5 ACCEPTABLE PRODUCTS

- .1 Luminaires described in the Lighting Fixture Schedule identify quality, performance criteria and other parameters, as indicated for this project. Named fixtures are acceptable with modifications and accessories, as indicated.
- .2 Fixtures from other manufacturers may be acceptable provided:
 - .1 Appearance and lighting performance are similar.
 - .2 Quality is equal or better.
 - .3 Lamp and ballast criteria remain the same.
 - .4 The fixture is provided with modifications and accessories to provide a complete product in keeping with the intent of the project.
 - .5 Approval in writing is obtained from the Owner's Representative to the supplier/manufacturer 5 days prior to tender closing date.

1.6 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate and recycle waste materials in accordance with Section 01 74 19 – Construction / Demolition Waste Management and Disposal.

- .2 Remove from site and dispose of all packaging materials at appropriate recycling facilities.
- .3 Collect and separate for disposal packaging material for recycling in accordance with Waste Management Plan.
- .4 Divert unused metal materials from landfill to metal recycling facility as approved by Consultant.
- .5 Fold up metal banding, flatten and place in designated area for recycling.

2.0 PRODUCTS

2.1 LAMPS

- .1 LED, as indicated.

2.2 BALLASTS

- .1 LED drivers:
 - .1 General requirements:
 - .1 Designed for 10 year operational life while operating at maximum case temperature and 90 percent non-condensing relative humidity.
 - .2 Designed and tested to withstand electrostatic discharges without impairment of performance when tested according to IEC 61000-4-2.
 - .3 UL 8750 recognized or listed as applicable.
 - .4 Complies with IEC 61347-2-13 as applicable.
 - .5 Surge Tolerance: Designed and tested to withstand Category A surges of 4,000 V according to IEEE C62.41.2 without impairment of performance.
 - .6 Manufactured in a facility that employs ESD reduction practices in compliance with ANSI/ESD S20.20.
 - .7 Class A sound rating; inaudible in a 27 dBA ambient.
 - .8 No visible change in light output with a variation of plus or minus 10 percent line voltage input.
 - .9 Total Harmonic Distortion (THD): Less than 20 percent for loads greater than 25W; complies with ANSI C82.11.

- .10 Drivers to track evenly across multiple lamp lengths and all light levels.
- .11 Configuration tool available to optimize the following for LED fixtures:
 - .1 Light level.
 - .2 Efficacy.
 - .3 Thermal performance.
- .2 3-wire control:
 - .1 Provide integral fault protection to prevent driver failure in the event of a mis-wire.
 - .2 Operate from input voltage of 120 V through 347 V at 60 Hz, or as indicated.
- .3 Product(s):
 - .1 Maximum Inrush Current: Meets NEMA 410 inrush requirements.
 - .2 Constant Current Drivers:
 - .1 Support from 220 mA to 1.4 A to ensure a compatible driver exists.
 - .2 Support LED arrays up to 60W.

2.3 FINISHES

- .1 Light fixture finish and construction to meet ULC listings and CSA certifications related to intended installation.

2.4 LUMINAIRES

- .1 As indicated in luminaire schedule on drawings.

2.5 OPTICAL CONTROL DEVICES

- .1 As indicated in luminaire schedule on drawings.

3.0 EXECUTION

3.1 INSTALLATION

- .1 Locate and install luminaires as indicated. Install lamps in all fixtures.

- .1 Provide adequate support to suit ceiling system.

3.2 WIRING

- .1 Connect luminaires to lighting circuits.
 - .1 Install flexible conduit for vertical power supply drop to luminaires as indicated. Horizontal wiring using flexible conduit is not permitted.

3.3 LUMINAIRE SUPPORTS

- .1 For suspended ceiling installations support luminaires from ceiling grid in accordance with local inspection requirements.

3.4 LUMINAIRE ALIGNMENT

- .1 Align luminaires mounted in continuous rows to form straight uninterrupted line.
- .2 Align luminaires mounted individually parallel or perpendicular to building grid lines.

3.5 FIELD QUALITY CONTROL

- .1 Perform tests in accordance with Section 26 05 00 – Common Work Results – Electrical.

END OF SECTION

1.0 GENERAL

1.1 SECTION INCLUDES

- .1 Materials and installation for emergency lighting systems.

1.2 RELATED SECTIONS

- .1 Section 01 33 00 - Submittal Procedures.
- .2 Section 26 05 00 - Common Work Results – Electrical.
- .3 Section 26 05 21 - Wires and Cables (0-1000 V).
- .4 Section 26 05 34 - Conduits, Conduit Fastenings and Conduit Fittings.

1.3 REFERENCES

- .1 Canadian Standards Association (CSA)
 - .1 CSA C22.2 No.141, Unit Equipment for Emergency Lighting.

1.4 SUBMITTALS

- .1 Data to indicate system components, mounting method, source of power and special attachments.

1.5 WARRANTY

- .1 For batteries, the ten years warranty period is extended to 120 months, with no-charge replacement during the first 5 years and pro-rate charge on the second 5 years from the date of Substantial Completion.

1.6 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate and recycle waste materials in accordance with Section 01 74 19 – Construction / Demolition Waste Management and Disposal.
- .2 Remove from site and dispose of all packaging materials at appropriate recycling facilities.
- .3 Collect and separate for disposal packaging material for recycling in accordance with Waste Management Plan.
- .4 Divert unused metal materials from landfill to metal recycling facility as approved by Consultant.

- .5 Fold up metal banding, flatten and place in designated area for recycling.

2.0 PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- .1 Acceptable Manufacturers include Beghelli, Emergi-Lite, Stanpro, Dual-Lite, Ready-Lite. All new fixtures shall be from the same manufacturer.

2.2 EQUIPMENT

- .1 Emergency lighting equipment: to CSA C22.2 No.141.
- .2 Supply voltage: 120 V, ac.
- .3 Output voltage: 12 or 24 V dc.
- .4 Operating time: as required by the latest edition of the OBC and NBC.
- .5 Battery: sealed, maintenance free.
- .6 Charger: solid state, multi-rate, voltage/current regulated, inverse temperature compensated, short circuit protected with regulated output of plus or minus 0.01V for plus or minus 10% input variations.
- .7 Solid state transfer circuit.
- .8 Low voltage disconnect: solid state, modular, operates at 80% battery output voltage.
- .9 Signal lights: solid state, for 'AC Power ON'.
- .10 Finish: standard.
- .11 Auxiliary equipment:
 - .1 Test switch.
 - .2 Time delay relay.
 - .3 Battery disconnect device.
 - .4 RFI suppressors.

3.0 EXECUTION

3.1 INSTALLATION



- .1 Install unit equipment and remote mounted fixtures.
- .2 Direct heads.
- .3 Connect exit lights to unit equipment.
- .4 Perform tests in accordance with Section 26 05 00 – Common Work Results - Electrical.

END OF SECTION

1.0 GENERAL

1.1 RELATED SECTIONS

- .1 Section 01 33 00 - Submittal Procedures.
- .2 Section 01 74 00 - Cleaning.
- .3 Section 26 05 00 - Common Work Results – Electrical.

1.2 REFERENCES

- .1 Atomic Energy Control Board Regulations
- .2 Canadian Code for Preferred Packaging
- .3 Canadian Standards Association (CSA)
 - .1 CSA C22.2 No.141, Unit Equipment for Emergency Lighting.
 - .2 CSA C860, Performance of Internally-Lighted Exit Signs.
- .4 National Fire Protection Association (NFPA)
 - .1 NFPA 101, Life Safety Code.

1.3 SUBMITTALS

- .1 Product Data:
 - .1 Submit manufacturer's printed product literature, specifications and datasheets and include product characteristics, performance criteria, physical size, finish and limitations.
- .2 Manufacturer's Instructions: Provide to indicate special handling criteria, installation sequence, cleaning procedures and disposal.

1.4 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate and recycle waste materials in accordance with Section 01 74 19 – Construction / Demolition Waste Management and Disposal.
- .2 Remove from site and dispose of all packaging materials at appropriate recycling facilities.
- .3 Collect and separate for disposal packaging material for recycling in accordance with Waste Management Plan.

- .4 Divert unused metal materials from landfill to metal recycling facility as approved by Consultant.
- .5 Fold up metal banding, flatten and place in designated area for recycling.

2.0 PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- .1 Acceptable Manufacturers include Beghelli, Lumacell, Stanpro, Emergi-Lite, ReadyLite, Dual Lite.
- .2 All new fixtures shall be from the same manufacturer.

2.2 SELF-POWERED UNITS

- .1 Exit lights: to CSA C22.2 No.141 and CSA C860, packaged in accordance with the Canadian Code for Preferred Packaging guidelines.
- .2 Housing: cold rolled steel minimum 1.0 mm thick, satin aluminum enamel finish.
- .3 Face and back plates: extruded aluminum.
- .4 Lamps: multiple - LED over 500,000 hours.
- .5 Operation: designed for 25 years of continuous operation without relamping.
- .6 Face: Green Running Man Pictogram.
- .7 Downlight: white glass in bottom of unit.
- .8 Face plate to remain captive for relamping.
- .9 Supply voltage: 120 V, ac.
- .10 Output voltage: 12 or 24 V dc.
- .11 Operating time: minimum 90 minutes and as required by code.
- .12 Recharge time: 12 hours
- .13 Battery: sealed, maintenance free, NiCd.

- .14 Charger: solid state, voltage/current regulated, inverse temperature compensated, short circuit protected, with regulated output of plus or minus 0.01 V for plus or minus 10% V input variation.
- .15 Solid state transfer circuit.
- .16 Signal lights: solid state, for 'AC Power ON'.
- .17 Mounting: suitable for universal mounting directly on junction box and c/w knockouts for conduit. Removable or hinged front panel for easy access to batteries.
- .18 Cabinet: finish: standard.
- .19 Auxiliary equipment:
 - .1 Test switch.
 - .2 AC/DC output terminal blocks inside cabinet.
 - .3 RFI suppressor.
 - .4 Cord and single twist-lock plug connection for AC power supply.

3.0 EXECUTION

3.1 INSTALLATION

- .1 Install exit lights to manufacturer's recommendations, listing requirements, NFPA standard and local regulatory requirements.
- .2 Connect fixtures to exit light circuits using RW90 wire in EMT conduit.
- .3 Connect emergency lamp sockets to emergency circuits.
- .4 Ensure that exit light circuit breaker is locked in on position.
- .5 Provide tests in accordance with Section 26 05 00 – Common Work Results – Electrical.

3.2 CLEANING

- .1 Proceed in accordance with Section 01 74 00 – Cleaning.
- .2 On completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.



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Section 26 53 00

Exit Signs

END OF SECTION



1.0 GENERAL

1.1 REFERENCES

- .1 Telecommunications Industries Association (TIA) / Electronic Industries Alliance (EIA).
 - .1 TIA/EIA-606, Administration Standard for the Commercial Telecommunications Infrastructure.
- .2 U.S. Department of Labor / Occupational Safety and Health Administration (OSHA)
 - .1 Nationally Recognized Testing Laboratory (NRTL).

1.2 SYSTEM DESCRIPTION

- .1 Telecommunications grounding and bonding system consist of grounding busbars, bonding backbones, and other bonding conductors.
- .2 Provides ground reference for telecommunications systems within building and bonding to it of telecommunications rooms.
- .3 Metallic pathways, cable shields, conductors, and hardware within telecommunications spaces are bonded to telecommunications grounding and bonding system.

1.3 QUALITY ASSURANCE

- .1 Products of This Section: Manufactured to ISO 14000, ISO 9000 and certification requirements.
- .2 Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum five (5) years documented experience.

1.4 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate and recycle waste materials in accordance with Section 01 74 19 – Construction / Demolition Waste Management and Disposal.
- .2 Remove from site and dispose of all packaging materials at appropriate recycling facilities.
- .3 Collect and separate for disposal packaging material for recycling in accordance with Waste Management Plan.
- .4 Divert unused metal materials from landfill to metal recycling facility as approved by Consultant.

- .5 Fold up metal banding, flatten and place in designated area for recycling.

2.0 PRODUCTS

2.1 TELECOMMUNICATIONS MAIN GROUNDING BUSBAR (TMGB)

- .1 Existing on second floor.

2.2 TELECOMMUNICATIONS GROUNDING BUSBAR (TGB)

- .1 Predrilled copper busbar, listed by NRTL, electrotin plated with holes 8 mm diameter for use with standard-sized lugs to: ANSI J-STD-607-A.
- .2 Dimensions 6 mm thick, 50 mm wide, 300 mm long to: ANSI J-STD-607-A.

2.3 BONDING CONDUCTOR FOR TELECOMMUNICATIONS

- .1 3/0 AWG copper conductor, green insulated to: ANSI J-STD-607-A.

2.4 TELECOMMUNICATIONS BONDING BACKBONE (TBB)

- .1 #1/0 AWG copper conductor, green insulated to: ANSI J-STD-607-A.

2.5 GROUNDING EQUALIZER (GE)

- .1 #1/0 AWG copper conductor, green insulated to: ANSI J-STD-607-A.

2.6 WARNING LABELS

- .1 Non-metallic warning labels in English and French to: ANSI J-STD-607-A.
- .2 Identify labels with wording "If this connector is loose or must be removed, please call the building telecommunications manager".

3.0 EXECUTION

3.1 TELECOMMUNICATIONS GROUNDING BUSBAR (TGB)

- .1 Install TGB in main terminal/equipment room and each telecommunications room.
- .2 Install #6 AWG copper bonding conductor from TGB to alternating current equipment ground (ACEG) of serving electrical power panel (panelboard).

3.2 BONDING CONDUCTORS GENERAL

- .1 When placed in ferrous metallic conduit or EMT longer than 1 m, bond to each end of conduit or EMT using grounding bushing.

3.3 TELECOMMUNICATIONS BONDING BACKBONE (TBB)

- .1 Install TBBs from TMGB to each TGB.
- .2 Use exothermic welding, approved 2 hole compression lugs for connection to TMGB and TGBs.

3.4 GROUNDING EQUALIZER (GE)

- .1 Install GE between TBBs in multi-storey building by bonding TGBs with GE on every floor.

3.5 BONDING TO TGB

- .1 Bond metallic raceways in telecommunications room to TGB using #6 AWG green insulated copper conductor.
- .2 For cables within telecommunications room having shield or metallic member, bond shield or metallic member to TGB using green insulated copper conductor.
- .3 Bond equipment racks and cabinets located in telecommunications room to TGB using #6 AWG green insulated copper conductor.

3.6 LABELLING

- .1 Apply warning labels to telecommunications bonding and grounding conductors.
- .2 Apply additional administrative labels to: TIA/EIA-606.

END OF SECTION

1.0 GENERAL

1.1 RELATED SECTIONS

- .1 Section 26 05 31 - Splitters, Junction, Pull Boxes and Cabinets.
- .2 Section 26 05 33.01 - Cable Trays for Electrical Systems.
- .3 Section 26 05 34 - Conduits, Conduit Fastenings and Conduit Fittings.

1.2 REFERENCES

- .1 Canadian Standards Association (CSA International).
 - .1 CAN/CSA C22.1 No.126.1, Metal Cable Tray Systems.
- .2 National Electrical Manufacturers Association (NEMA)
 - .1 NEMA VE 1, Metal Cable Tray Systems.
 - .2 NEMA VE 2, Cable Tray Installation Guidelines.

1.3 SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittals.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for communication raceway systems and include product characteristics, performance criteria, physical size, finish and limitations.

1.4 SYSTEM DESCRIPTION

- .1 Empty telecommunications raceway system for telephone, data TV consists of outlet boxes, cover plates, conduits, cabletroughs, pull boxes, sleeves and caps, fish wires, service fittings as indicated. Sizes of all raceways as per drawing.
- .2 Overhead ceiling distribution system within interior of building.

1.5 QUALITY ASSURANCE

- .1 Products of This Section: Manufactured to ISO 14000, ISO 9000 and certification requirements.

- .2 Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum five (5) years documented experience.

1.6 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate and recycle waste materials in accordance with Section 01 74 19 – Construction / Demolition Waste Management and Disposal.
- .2 Remove from site and dispose of all packaging materials at appropriate recycling facilities.
- .3 Collect and separate for disposal packaging material for recycling in accordance with Waste Management Plan.
- .4 Divert unused metal materials from landfill to metal recycling facility as approved by Consultant.
- .5 Fold up metal banding, flatten and place in designated area for recycling.

2.0 PRODUCTS

2.1 MATERIAL

- .1 Conduits: EMT type, in accordance with Section 26 05 34 - Conduits, Conduit Fastenings and Conduit Fittings.
- .2 J-Hooks: Pre-galvanized complete with retainer clips.
- .3 Junction boxes, cabinets type [E] [T]: in accordance with Section 26 05 31 - Splitters, Junction, Pull Boxes and Cabinets.
- .4 Outlet boxes, conduit boxes, and fittings: in accordance with Section 26 05 32 – Outlet Boxes, Conduit Boxes and Fittings.
- .5 Fish wire: polypropylene type.

3.0 EXECUTION

3.1 EXAMINATION

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

- .2 Inform the Client's Representative of unacceptable conditions immediately upon discovery.
- .3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of approval to proceed from the Client's Representative.

3.2 INSTALLATION

- .1 Install empty raceway system, including underfloor and overhead distribution system, fish wire, terminal cabinets, outlet boxes, floor boxes, pull boxes, cover plates, conduit, sleeves and caps, miscellaneous and positioning material to constitute complete system.

3.3 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 13 – Progressive Cleaning.
 - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 13 – Progressive Cleaning.

3.4 PROTECTION

- .1 Protect installed products and components from damage during construction.
- .2 Repair damage to adjacent materials caused by pathways for communications systems installation.

END OF SECTION

1.0 GENERAL

1.1 RELATED WORK

- .1 Section 01 33 00 - Submittal Procedures.
- .2 Section 01 78 00 - Closeout Procedures.
- .3 Section 26 05 00 - Common Work Results - Electrical.
- .4 Section 26 05 21 - Wires and Cables (0 - 1000 V).
- .5 Section 26 05 34 - Conduits, Conduit Fastenings and Conduit Fittings.
- .6 Section 28 16 00 - Intrusion Detection.

1.2 REFERENCES

- .1 Underwriter's Laboratories of Canada (ULC)
 - .1 CAN/ULC-S524, Installation of Fire Alarm Systems.
 - .2 ULC-S525, Audible Signal Appliances for Fire Alarm.
 - .3 CAN/ULC-S526, Visual Signal Appliances, Fire Alarm.
 - .4 CAN/ULC-S527, Control Units, Fire Alarm.
 - .5 CAN/ULC-S528, Manual Pull Stations.
 - .6 CAN/ULC-S529, Smoke Detectors, Fire Alarm.
 - .7 CAN/ULC-S530, Heat Actuated Fire Detectors, Fire Alarm.
 - .8 CAN/ULC-S536, Inspection and Testing of Fire Alarm Systems.
 - .9 CAN/ULC-S537, Verification of Fire Alarm Systems.
 - .10 CAN/ULC-S1001, Standard for Integrated Systems Testing.

1.3 SYSTEM DESCRIPTION

- .1 Fully supervised, microprocessor-based, remote monitored fire alarm system, utilizing digital techniques for data control and multiplexing techniques for data transmission.

- .2 System to carry out fire alarm and protection functions; including receiving alarm signals; initiating general alarm; supervising components and wiring; actuating auxiliary functions; initiating trouble signals and signaling to central monitoring system.
- .3 Zoned, non-coded single stage.
- .4 Modular in design to allow for future expansion.
- .5 Operation of system shall not require personnel with special computer skills.
- .6 System to include:
 - .1 Central Control Unit in separate enclosure with power supply, stand-by batteries, central processor with microprocessor and logic interface, main system memory, input-output interfaces for alarm receiving, annunciation/display, and program control/signaling.
 - .2 Power supplies.
 - .3 Initiating/input circuits.
 - .4 Output circuits.
 - .5 Auxiliary circuits.
 - .6 Wiring.
 - .7 Manual and automatic initiating devices.
 - .8 Audible and visual signaling devices.
 - .9 End-of-line resistors.
 - .10 Local and Remote annunciators.
 - .11 Historic event recorder.
 - .12 Drill button on main panel.

1.4 REQUIREMENTS OF REGULATORY AGENCIES

- .1 System:
 - .1 Subject to Provincial Fire Commissioner's approval.
 - .2 Subject to FC inspection for final acceptance.

- .3 To electrical inspection approval.
- .2 System components: listed by ULC and comply with applicable provisions of National Building Code and meet requirements of local authority having jurisdiction.

1.5 SUBMITTALS

- .1 Include:
 - .1 Detail assembly and internal wiring diagrams for control unit.
 - .2 Details for devices.
 - .3 Details and performance specifications for control, annunciation and peripherals with item by item cross reference to specification for compliance.
 - .4 Step-by-step operating sequence, cross referenced to logic flow diagram.

1.6 CLOSEOUT SUBMITTALS

- .1 Provide operation and maintenance data for fire alarm system for incorporation into manual specified in Section 01 78 00- Closeout Submittals.
- .2 Include:
 - .1 Instructions for complete fire alarm system to permit effective operation and maintenance.
 - .2 Technical data - illustrated parts list with parts catalogue numbers.
 - .3 Copy of approved shop drawings with corrections completed and marks removed except review stamps.
 - .4 List of recommended spare parts for system.

1.7 MAINTENANCE MATERIALS

- .1 Provide the following maintenance materials:
 - .1 Two (2) spare thermal detectors.
 - .2 Two (2) spare smoke detectors.
 - .3 Two (2) spare duct smoke detectors.

1.8 MAINTENANCE

- .1 Provide one year, s free maintenance from date of substantial completion with two inspections by manufacturer during warranty period and following occupancy. Inspection tests to conform to CAN/ULC-S536. Submit inspection report to Owner.

1.9 TRAINING

- .1 Provide on-site lectures and demonstration by fire alarm equipment manufacturer to train operational personnel in use and maintenance of fire alarm system.

1.10 WARRANTY

- .1 Provide manufacturer produce warranty against defects in operation, material and workmanship for 2 years from date of substantial completion.

1.11 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate and recycle waste materials in accordance with Section 01 74 19 – Construction / Demolition Waste Management and Disposal.
- .2 Remove from site and dispose of all packaging materials at appropriate recycling facilities.
- .3 Collect and separate for disposal packaging material for recycling in accordance with Waste Management Plan.
- .4 Divert unused metal materials from landfill to metal recycling facility as approved by Consultant.
- .5 Fold up metal banding, flatten and place in designated area for recycling.

2.0 PRODUCTS

2.1 MATERIALS

- .1 Equipment and devices: ULC listed and labeled and supplied by single manufacturer.
- .2 Power supply: to CAN/ULC-S524.
- .3 Audible signal devices: to ULC-S524.
- .4 Visual signal devices: to CAN/ULC-S526.
- .5 Control unit: to CAN/ULC-S527.
- .6 Manual pull stations: to CAN/ULC-S528.

.7 Thermal detectors: to CAN/ULC-S530.

.8 Smoke detectors: to CAN/ULC-S529.

2.2 SYSTEM OPERATION: SINGLE STAGE

.1 Actuation of any alarm initiating device to:

.1 Cause electronic latch to lock-in alarm at central control unit.

.2 Indicate zone of alarm at central control unit.

.3 Cause audible signaling devices to sound continuously throughout building and at central control unit.

.4 Transmit signal to monitoring agency via alarm panel.

.5 Cause air conditioning and ventilation units to shut down.

.2 Acknowledging alarm: indicated at central control unit.

.3 Possible to silence signals by Alarm silence@ switch at control unit, after 60 second period of operation.

.4 Subsequent alarm, received after previous alarm has been silenced, to re-activate signals.

.5 Actuation of supervisory devices to:

.1 Cause electronic latch to lock-in supervisory state at central control unit.

.2 Indicate respective supervisory zone at central control unit.

.3 Cause audible signal at central control unit to sound.

.4 Activate common supervisory sequence.

.6 Resetting alarm or supervisory device not to return system indications/functions back to normal until control unit has been reset.

.7 Trouble on system to:

.1 Indicate circuit in trouble at central control unit.

.2 Activate Asystem trouble@ indication, buzzer and common trouble sequence. Acknowledging trouble condition to silence audible indication; whereas visual indication to remain until trouble is cleared and system is back to normal.

- .8 Trouble on system to be suppressed during course of alarm.
- .9 Trouble condition on any circuit in system not to initiate any alarm conditions.

2.3 CONTROL PANEL

- .1 Central control unit (CCU).
 - .1 Suitable for DCLA communication style: to CAN/ULC - S524.
 - .2 Features specified are minimum requirements for microprocessor-based system with digital data control and digital multiplexing techniques for data transmission.
 - .3 Minimum capacity of 250 addressable monitoring and 250 addressable control/signal points.
 - .4 System to provide for priority reporting levels, with fire alarm points assigned highest priority, supervisory and monitoring lower priority, and third priority for troubles. Possible to assign control priorities to control units in system to guarantee operation or allow emergency override as required.
 - .5 Integral power supply, battery charger and standby batteries.
 - .6 Basic life safety software: retained in non-volatile Erasable Programmable Read-Only-Memory (EPROM). Extra memory chips: easily field-installed. Random-Access Memory (RAM) chips in panel to facilitate password-protected field editing of simple software functions (e.g. zone labels, priorities) and changing of system operation software.
 - .7 Circuitry to continuously monitor communications and data processing cycles of microprocessor. Upon failure, audible and visual trouble indication to activate.
 - .8 Support up to 2 RS-232-C I/O ports. CCU output: parallel ASCII.
 - .9 Equipped with software routines to provide Event-Initiated-Programs (EIP); change in status of one or more monitor points, may be programmed to operate any or all of system, s control points.
 - .10 Software and hardware to maintain time of day, day of week, day of month, month and year.

2.4 POWER SUPPLIES

- .1 120 V, 60 Hz as primary source of power for system.

- .2 Voltage regulated, current limited distributed system power.
- .3 Primary power failure or power loss (less than 102 V) will activate common trouble sequence.
- .4 Interface with battery charger and battery to provide uninterruptible transfer of power to standby source during primary power failure or loss.
- .5 During normal operating conditions fault in battery charging circuit, short or open in battery leads to activate common trouble sequence and standby power trouble indicator.
- .6 Standby batteries: sealed, maintenance free.
- .7 Continuous supervision of wiring for external initiating and alarm circuits to be maintained during power failure.

2.5 INITIATING/INPUT CIRCUITS

- .1 Receiving circuits for alarm initiating devices such as manual pull stations, smoke detectors, and heat detectors wired in DCLA configuration to central control unit.
- .2 Alarm receiving circuits (active and spare): compatible with smoke detectors and open contact devices.
- .3 Actuation of alarm initiating device: cause system to operate as specified in "System Operation".
- .4 Receiving circuits for supervisory, N/O devices. Devices: wired in DCLA configuration to central control unit.
- .5 Actuation of supervisory initiating device: cause system to operate as specified in "System Operation".

2.6 ALARM OUTPUT CIRCUITS

- .1 Alarm output circuit: connected to signals, wired in class B configuration to central control unit.
 - .1 Signal circuits operation to follow system programming; capable of sounding horns continuously. Each signal circuit: rated at 2 A, 24 V DC; fuse-protected from overloading/overcurrent.
 - .2 Manual alarm silence, automatic alarm silence and alarm silence inhibit to be provided by system's common control.

2.7 AUXILIARY CIRCUITS

- .1 Auxiliary contacts for control functions.
- .2 Actual status indication (positive feedback) from controlled device.
- .3 Alarm or supervisory trouble on system to cause operation of programmed auxiliary output circuits.
- .4 Upon resetting system, auxiliary contacts to return to normal or to operate as pre-programmed.
- .5 Auxiliary circuits: rated at 2 A, 24 V DC or 120 V AC, fuse-protected.
- .6 Auxiliary contacts for shut down of all ventilation/exhaust units indicated.
- .7 Auxiliary contacts for Building Automation System.

2.8 WIRING

- .1 Multi-conductor cable assemblies with dedicated bonding wire CSA FAS105 and FT-4 rated.
- .2 To initiating circuits: 18 AWG minimum, and in accordance with manufacturer's requirements.
- .3 To signal circuits: 16 AWG minimum, and in accordance with manufacturer's requirements.
- .4 To control circuits: 14 AWG minimum, and in accordance with manufacturer's requirements.
- .5 Fire alarm cables to be run in EMT conduit unless otherwise noted.

2.9 MANUAL ALARM STATIONS

- .1 Addressable manual pull station.
 - .1 Pull lever, break glass rod, semi-flush wall mounted type, single action, single stage, electronics to communicate station's status to addressable module/transponder over 2 wires and to supply power to station. Station address to be set on station in field.

2.10 AUTOMATIC ALARM INITIATING DEVICES

- .1 Addressable thermal fire detectors, combination fixed temperature and rate of rise, non-restorable fixed temperature element, self-restoring rate of rise, fixed temperature 57EC, rate of rise 8.3 EC per minute.
 - .1 Electronics to communicate detector's status to addressable module/transponder.
 - .2 Detector address to be set on detector in field.

- .2 Addressable thermal fire detector, fixed temperature, non-restorable, rated 57EC.
 - .1 Electronics to communicate detector's status to addressable module/transponder.
 - .2 Detector address to be set on detector in field.
- .3 Addressable variable-sensitivity smoke detectors.
 - .1 Photo-electric type.
 - .2 Electronics to communicate detector's status to addressable module/transponder.
 - .3 Detector address to be set on detector in field.
- .4 Addressable thermal fire detector, fixed temperature, non-restorable, rated 57EC constructed of moisture proof design.
 - .1 Electronics to communicate detector's status to addressable module/transponder.
 - .2 Detector address to be set on detector in field.
- .5 Sensitivity settings: 3 settings, determined and operated by control panel. No shifting in detector sensitivity due to atmospheric conditions (dust, dirt) within certain parameters.
- .6 Ability to annunciate minimum of 2 levels of detector contamination automatically with trouble condition at control panel.

2.11 AUDIBLE SIGNAL DEVICES

- .1 Vibrating horn: semi-flush mounted, red enamel, 24 V DC, 94 dB.
- .2 Exterior horns to be weatherproof design mounted in PVC yard hood.

2.12 VISUAL ALARM SIGNAL DEVICES

- .1 Strobe: flashing white, 24 V dc semi-flush mounted in finished areas.

2.13 END-OF-LINE DEVICES

- .1 End-of-line devices to control supervisory current in signaling circuits sized to ensure correct for each circuit. Open, short or ground fault in any circuit will alter supervisory current in that circuit, producing audible and visible alarm at main control panel and remotely as indicated.

2.14 ADDRESSABLE CONTROL/MONITOR MODULES

- .1 Addressable modules with address set in field for control/monitoring of external circuits.

- .2 Applications: ventilation unit shut down, sprinkler device monitoring, control of magnetic door hold open devices, door electric strikes, interface to electronic door hardware controllers to facilitate door control functions when required.
- .3 Ensure that control circuits connected to addressable relay dry contacts are protected by fuse to limit current within manufacturer's requirements.

2.15 AS-BUILT RISER DIAGRAM

- .1 Fire alarm system riser diagram: in glazed frame minimum size 600 x 600 mm.
- .2 Provide complete riser diagram indicating all devices in relative position on communications loop. Indicate location of each device by Block reference and room name and number.
- .3 Locate riser diagram in main electrical room.

2.16 ISOLATION MODULES

- .1 Isolation modules for segmenting of fire alarm detection loop as indicated.

2.17 PASSIVE GRAPHIC DISPLAY

- .1 Provide passive graphic display, to be mounted adjacent to the main fire alarm control panel. Plastic laminate type, black artwork on white background, framed under glass approximately size: 600 x 600 mm.

2.18 REMOTE ANNUNCIATOR

- .1 LCD type annunciator providing information as per display on control panel display, to be located in main lobby of building.

2.19 WIRE GUARDS

- .1 Provide factory manufactured wire guards in gymnasium for protection of manual pull stations, fire detectors, strobe lights and alarm horns.

2.20 REMOTE MONITORING

- .1 Provide remote monitoring of fire alarm status to monitoring agency. Retain services of intrusion alarm service representative for connection to and programming of intrusion alarm control panel to accommodate alarm from fire alarm system. Include all charges in Division 26 Electrical Contract.

3.0 EXECUTION

3.1 MANUFACTURER'S INSTRUCTIONS

- .1 Install systems in accordance with CAN/ULC-S524.
- .2 Run all fire alarm wiring in conduit.
- .3 Install central control unit and connect to ac power supply.
- .4 Install manual alarm stations and connect to alarm circuit wiring.
- .5 Locate and install detectors and connect to alarm circuit wiring. Do not mount detectors within 1 m of air outlets. Maintain at least 600 mm radius clear space on ceiling, below and around detectors. Locate duct type detectors in straight portions of ducts.
- .6 Connect alarm circuits to main control panel.
- .7 Install horns and visual signal devices and connect to signaling circuits.
- .8 Connect signaling circuits to main control panel.
- .9 Install end-of-line devices at end of signaling circuits.
- .10 Install wiring to ventilation units as identified for shut down under alarm conditions.
- .11 Splices are not permitted.
- .12 Provide necessary raceways, cables and wiring to make interconnections to terminal boxes, annunciator equipment and CCU, as required by equipment manufacturer.
- .13 Ensure that wiring is free of opens, shorts or grounds, before system testing and handing over.
- .14 Identify circuits and other related wiring at central control unit, annunciators, and terminal boxes.
- .15 Connect fire alarm control panel to intrusion alarm control panel for remote monitoring.
- .16 Install factory wire guards in gymnasium on pull stations, fire detectors, strobes and fire alarm horns.
- .17 Install remote annunciator and connect to main control panel.

3.2 FIELD QUALITY CONTROL

- .1 Perform tests in accordance with Section 26 05 00 – Common Work Results - Electrical.
- .2 Fire alarm system:

- .1 Test each device and alarm circuit to ensure manual stations, thermal and smoke detectors transmit alarm to control panel and actuate general alarm and ancillary devices.
- .2 Check annunciator panels to ensure alarms are shown correctly.
- .3 Simulate grounds and breaks on alarm and signaling circuits to ensure proper operation of system.
- .4 Addressable circuits system style DCLA:
 - .1 Test each conductor on all DCLA addressable links for capability of providing 3 or more subsequent alarm signals on each side of single open-circuit fault condition imposed near midmost point of each link. Operate Acknowledge/Silence switch after reception of each of the 3 signals. Correct imposed fault after completion of each series of tests.
 - .2 Test each conductor on all DCLA addressable links for capability of providing 3 or more subsequent alarm signals during ground-fault condition imposed near midmost point of each link. Operate Acknowledge/Silence switch after reception of each of the 3 signals. Correct imposed fault after completion of each series of tests.
- .3 Provide final PROM program re-burn for system incorporating program changes made during construction.
- .4 Provide programming for system to provide identification of alarm and trouble conditions to satisfaction of the owner. Coordinate with the owner prior to programming display items.
- .5 Complete audibility testing for locations with new signalling devices or where architectural layouts have been revised.
6. Provide testing and verification of all existing initiating and signalling devices once connected to new panel.
7. Complete CAN/ULC S1001 standard for integrated systems testing which shall be performed as part of the system replacement work.

END OF SECTION

1.0 GENERAL

1.1 RELATED SECTIONS

- .1 Section 01 33 00 – Submittal Procedures.

1.2 REFERENCES

- .1 American Society for Testing and Materials (ASTM).
 - .1 ASTM C117, Standard Test Method for Material Finer Than 0.075 mm (No. 200) Sieve in Mineral Aggregates by Washing.
 - .2 ASTM C136, Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates.
 - .3 ASTM D422, Standard Test Method for Particle-Size Analysis of Soils.
 - .4 ASTM D698, Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft³) (600 kN-m/m³).
 - .5 ASTM D1557, Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft³) (2,700 kN-m/m³).
 - .6 ASTM D4318, Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils.
- .2 Canadian General Standards Board (CGSB).
 - .1 CAN/CGSB-8.1, Sieves, Testing, Woven Wire, Inch Series.
 - .2 CA/CGSB-8.2, Sieves, Testing, Woven Wire, Metric
- .3 Canadian Standards Association (CSA)
 - .1 CAN/CSA-A3000, Cementitious Materials Compendium (Consists of A3001, A3002, A3003, A3004 and A3005).
 - .1 CSA-A3001, Cementitious Materials for Use in Concrete.
 - .2 CSA-A23.1/A23.2, Concrete Materials and Methods of Concrete Construction/ Methods of Test and Standard Practices for Concrete.

1.3 DEFINITIONS

- .1 Excavation classes: two classes of excavation will be recognized; common excavation and rock excavation.
 - .1 Rock excavation: excavation of material from solid masses of igneous, sedimentary or metamorphic rock which, prior to its removal, was integral with



its parent mass, and boulders or rock fragments having individual volume in excess of 1 m³. Frozen material not classified as rock.

- .2 Common excavation: excavation of materials of whatever nature, which are not included under definitions of rock excavation.
- .2 Unclassified excavation: excavation of deposits of whatever character encountered in work.
- .3 Topsoil: material capable of supporting good vegetative growth and suitable for use in top dressing, landscaping and seeding.
- .4 Waste material: excavated material unsuitable for use in work or surplus to requirements.
- .5 Borrow material: material obtained from locations outside area to be graded, and required for construction of fill areas or for other portions of work.
- .6 Unsuitable materials:
 - .1 Weak and compressible materials under excavated areas.
 - .2 Frost susceptible materials under excavated areas.
 - .3 Frost susceptible materials:
 - .1 Fine grained soils with plasticity index less than 10 when tested to ASTM D4318, and gradation within limits specified when tested to ASTM D422 and ASTM C136: Sieve sizes to CAN/CGSB-8.1.

<u>Sieve Designation</u>	<u>%Passing</u>
2.00 mm	100
0.10 mm	45-100
0.02 mm	10-80
<u>0.005 mm</u>	<u>0-45</u>

- .2 Coarse grained soils containing more than 20% by mass passing 0.075 mm sieve.

1.4 SUBMITTALS

- .1 Inform Owner’s Representative at least 4 weeks prior to commencing work, of proposed source of fill materials and provide access for sampling.
- .2 Submit 70 kg samples of type of fill specified including representative samples of excavated material.

- .3 Ship samples as directed by Owner's Representative in tightly closed containers to prevent contamination.

1.5 QUALITY ASSURANCE

- .1 Submit design and supporting data at least 2 weeks prior to commencing work.
- .2 Design and supporting data submitted to bear stamp and signature of qualified professional engineer registered or licensed in the province of Newfoundland and Labrador.
- .3 Keep design and supporting data on site.
- .4 Engage services of qualified professional engineer who is registered or licensed in Province of Newfoundland and Labrador to design and inspect cofferdams, shoring, bracing and underpinning required for work.
- .5 Do not use soil material until written report of soil test results are reviewed and approved by Owner's Representative.

1.6 EXISTING CONDITIONS

- .1 Buried services:
 - .1 Before commencing work verify location of buried services on and adjacent to site.
 - .2 Arrange with appropriate authority for relocation of buried services that interfere with execution of work: pay costs of relocating services.
 - .3 Remove obsolete buried services within 2 m of foundations: cap cut-offs.
 - .4 Size, depth and location of existing utilities and structures as indicated are for guidance only. Completeness and accuracy are not guaranteed.
 - .5 Prior to commencing excavation work, notify applicable Owner or authorities having jurisdiction, establish location and state of use of buried utilities and structures. Owners or authorities having jurisdiction to clearly mark such locations to prevent disturbance during work.
 - .6 Confirm locations of buried utilities by careful test excavations.
 - .7 Maintain and protect from damage, water, sewer, gas, electric, telephone and other utilities and structures encountered as indicated.
 - .8 Where utility lines or structures exist in area of excavation, obtain direction of Owner's Representative before removing or re-routing.
 - .9 Record location of maintained, re-routed and abandoned underground lines.
-



- .10 Confirm locations of recent excavations adjacent to area of excavation.
- .2 Existing buildings and surface features:
 - .1 Conduct, with Owner’s Representative condition survey of existing buildings, trees and other plants, lawns, fencing, service poles, wires, rail tracks, pavement, survey bench marks and monuments which may be affected by work.
 - .2 Protect existing buildings and surface features from damage while work is in progress. In event of damage, immediately make repair to approval of Owner’s Representative.
 - .3 Where required for excavation, cut roots or branches as approved by Owner’s Representative.

2.0 PRODUCTS

2.1 MATERIALS

- .1 Backfill Type 1 and Type 2 fill: properties to Section 31 05 16 - Aggregates for Earthwork and the following requirements:
- .2 Crushed, pit run or screened stone, gravel or sand.
- .3 Gradations to be within limits specified when tested to ASTM C136 and ASTM C117. Sieve sizes to CAN/CGSB-8.1.

Sieve Designation	%Passing	
	<u>Type1</u>	<u>Type2</u>
75 mm	-	100
50 mm	-	-
37.5 mm	-	-
25 mm	100	-
19 mm	75-100	-
12.5 mm	-	-
9.5 mm	50-100	-
4.75 mm	30-70	22-85
2.00 mm	20-45	-
0.425 mm	10-25	5-30
0.180 mm	-	-
<u>0.075 mm</u>	<u>3-8</u>	<u>0-10</u>

- .2 Type 3 fill: selected material from excavation or other sources, approved by Owner’s Representative for use intended, unfrozen and free from rocks larger than 75 mm, cinders, ashes, sods, refuse or other deleterious materials.



3.0 EXECUTION

3.1 SITE PREPARATION

- .1 Remove obstructions, ice and snow, from surfaces to be excavated within limits indicated.

3.2 PREPARATION/PROTECTION

- .1 Protect existing features in accordance with Section 01 56 00 - Temporary Barriers and Enclosures and applicable local regulations.
- .2 Keep excavations clean, free of standing water, and loose soil.
- .3 Where soil is subject to significant volume change due to change in moisture content, cover and protect to Owner's Representative's approval.
- .4 Protect natural and man-made features required to remain undisturbed. Unless otherwise indicated or located in an area to be occupied by new construction, protect existing trees from damage. Protect buried services that are required to remain undisturbed.

3.3 STRIPPING OF TOPSOIL

- .1 Commence topsoil stripping of areas as indicated by Owner's Representative after area has been cleared of brush, weeds and grasses and removed from site.
- .2 Strip topsoil to depths as indicated by Owner's Representative. Do not mix topsoil with subsoil.
- .3 Stockpile in locations as directed by Owner's Representative. Stockpile height not to exceed 2 m.
- .4 Dispose of unused topsoil as directed by Owner's Representative.

3.4 STOCKPILING

- .1 Stockpile fill materials in areas designated by Owner's Representative. Stockpile granular materials in manner to prevent segregation.
- .2 Protect fill materials from contamination.

3.5 COFFERDAMS, SHORING, BRACING AND UNDERPINNING

- .1 Maintain sides and slopes of excavations in safe condition by appropriate methods and in accordance with Section 01 35 30 - Health and Safety Requirements and Occupational Health and Safety Act for the Province of Newfoundland and Labrador.
- .2 Obtain permit from authority having jurisdiction for temporary diversion of water course.
- .3 Construct temporary works to depths, heights and locations as indicated or approved by Owner's Representative.
- .4 During backfill operation:
 - .1 Unless otherwise as indicated or as directed by Owner's Representative remove sheeting and shoring from excavations.
 - .2 Do not remove bracing until backfilling has reached respective levels of such bracing.
 - .3 Pull sheeting in increments that will ensure compacted backfill is maintained at an elevation at least 500 mm above toe of sheeting.
- .5 When sheeting is required to remain in place, cut off tops at elevations as indicated.
- .6 Upon completion of substructure construction:
 - .1 Remove cofferdams, shoring and bracing.
 - .2 Remove excess materials from site and restore water courses as indicated and as directed by Owner's Representative.

3.6 DEWATERING AND HEAVE PREVENTION

- .1 Keep excavations free of water while work is in progress.
 - .2 Submit for Owner's Representative's review details of proposed dewatering or heave prevention methods, such as dikes, well points, and sheet pile cut-offs.
 - .3 Avoid excavation below groundwater table if quick condition or heave is likely to occur. Prevent piping or bottom heave of excavations by groundwater lowering, sheet pile cut-offs, or other means.
 - .4 Protect open excavations against flooding and damage due to surface run-off.
 - .5 Dispose of water in accordance with Section 01 35 43 - Environmental Procedures and in manner not detrimental to public and private property, or any portion of work completed or under construction.
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- .6 Provide flocculation tanks, settling basins, or other treatment facilities to remove suspended solids or other materials before discharging to storm sewers, water courses or drainage areas.

3.7 EXCAVATION

- .1 Excavate to lines, grades, elevations and dimensions as indicated by Owner's Representative.
 - .2 Remove concrete, masonry, paving, walks, demolished foundations and rubble and other obstructions encountered during excavation in accordance with Section 02 41 13 - Selective Site Demolition.
 - .3 Excavation must not interfere with bearing capacity of adjacent foundations.
 - .4 Do not disturb soil within branch spread of trees or shrubs that are to remain. If excavating through roots, excavate by hand and cut roots with sharp axe or saw.
 - .5 For trench excavation, unless otherwise authorized by Owner's Representative in writing, do not excavate more than 30 m of trench in advance of installation operations and do not leave open more than 15 m at end of day's operation.
 - .6 Keep excavated and stockpiled materials a safe distance away from edge of trench as directed by Owner's Representative.
 - .7 Restrict vehicle operations directly adjacent to open trenches.
 - .8 Dispose of surplus and unsuitable excavated material off site.
 - .9 Do not obstruct flow of surface drainage or natural watercourses.
 - .10 Earth bottoms of excavations to be undisturbed soil, level, free from loose, soft or organic matter.
 - .11 Notify Owner's Representative when bottom of excavation is reached.
 - .12 Obtain Owner's Representative approval of completed excavation.
 - .13 Remove unsuitable material from trench bottom to extent and depth as directed by Owner's Representative.
 - .14 Correct unauthorized over-excavation as follows:
-

- .1 Fill under bearing surfaces and footings with concrete specified for footings.
- .2 Fill under other areas with Type 2 fill compacted to not less than 95% of corrected maximum dry density.
- .15 Hand trim, make firm and remove loose material and debris from excavations. Where material at bottom of excavation is disturbed, compact foundation soil to density at least equal to undisturbed soil. Clean out rock seams and fill with concrete mortar or grout to approval of Owner's Representative.

3.8 FILL TYPES AND COMPACTION

- .1 Use fill of types as indicated or specified below. Compaction densities are percentages of maximum densities obtained from ASTM D698 corrected maximum dry density.
 - .1 Exterior side of perimeter walls: use Type 3 fill to subgrade level. Compact to 95%.
 - .2 Within building area: use Type 2 to underside of base course for floor slabs. Compact to 98%.
 - .3 Under concrete slabs: provide 150 mm compacted thickness base course of Type 1 fill to underside of slab. Compact base course to 100%.
 - .4 Retaining walls: use Type 2 fill to subgrade level on high side for minimum 500 mm from wall and compact to 95%. For remaining portion, use Type 3 fill compacted to 95%.
 - .5 To correct over excavation in trenches: use Type 2 fill to underside of sand bedding compacted to 95%.

3.9 BEDDING AND SURROUND OF UNDERGROUND SERVICES

- .1 Place and compact granular material for bedding and surround of underground services as indicated.
- .2 Place bedding and surround material in unfrozen condition.

3.10 BACKFILLING

- .1 Vibratory compaction equipment: approved by Owner's Representative.
 - .2 Do not proceed with backfilling operations until Owner's Representative has inspected and approved installations.
 - .3 Areas to be backfilled to be free from debris, snow, ice, water and frozen ground.
 - .4 Do not use backfill material which is frozen or contains ice, snow or debris.
-

- .5 Place backfill material in uniform layers not exceeding 150 mm compacted thickness up to grades indicated. Compact each layer before placing succeeding layer.
- .6 Backfill around installations.
 - .1 Place bedding and surround material as specified elsewhere.
 - .2 Do not backfill around or over cast-in-place concrete within 24 hours after placing of concrete.
 - .3 Place layers simultaneously on both sides of installed work to equalize loading. Difference not to exceed 600 mm.
 - .4 Where temporary unbalanced earth pressures are liable to develop on walls or other structures.
 - .1 Permit concrete to cure for minimum 14 days or until it has sufficient strength to withstand earth and compaction pressure, and approval obtained from Owner's Representative, or
 - .2 If approved by Owner's Representative, erect bracing or shoring to counteract unbalance, and leave in place until removal is approved by Owner's Representative.

3.11 RESTORATION

- .1 Upon completion of work, remove waste materials and debris, trim slopes, and correct defects as directed by Owner's Representative.
- .2 Replace topsoil as indicated by Owner's Representative.
- .3 Reinstate lawns to elevation which existed before excavation.
- .4 Reinstate pavement and sidewalks distributed by excavation to thickness, structure, and elevation which existed before excavation.
- .5 Clean and reinstate areas affected by work as directed by Owner's Representative.
- .6 Use temporary plating to support traffic loads over unshrinkable fill for initial 24 h.

END OF SECTION

1.0 GENERAL

1.1 SECTION INCLUDES

- .1 Provision of rigid conduit and concrete - encased underground service ducts.

1.2 RELATED SECTIONS

- .1 Section 01 33 00 – Submittal Procedures.
- .2 Section 01 74 21 – Construction/Demolition Waste Management and Disposal.
- .3 Section 26 05 00 - Common Work Results - Electrical.
- .4 Section 26 05 28 - Grounding - Secondary.
- .5 Section 26 05 34 - Conduits, Conduit Fastenings and Conduit Fittings.
- .6 Section 26 05 43.01 - Installation of Cables in Trenches and in Ducts.

1.3 REFERENCES

- .1 Canadian Standards Association (CSA)
 - .1 CSA A23.1/A23.2, Concrete Materials and Methods of Concrete Construction/Methods of Test for Concrete.

1.4 REGULATORY REQUIREMENTS

- .1 Co-ordinate and meet requirements of power supply authority. Ensure availability of power when required. Use cash allowance as per Section 01 21 00 – Allowances to cover costs associated with contribution-in-aid of construction to Utility authority for provision of building permanent power supply.

2.0 PRODUCTS

2.1 MATERIALS

- .1 Underground ducts: Concrete Encased Duct Banks, DBII type.
- .2 Epoxy coated rigid steel galvanized conduit and fittings: to Section 26 05 34 - Conduits, Conduit Fastenings and Conduit Fittings. Use for sections extending above finished grade.

- .3 Conductors: copper, type RWU-90, to Section 26 05 21 – Wires and Cables (0 -1000v), size and number of conductors as indicated.
- .4 Concrete: to CSA A23.1/A23.2 and Division 3 - Concrete.
- .5 Backfill: clean and free from debris.
- .6 Pulling Iron:
 - .1 22 mm diameter hot dipped galvanized steel bar with exposed triangular shaped opening.

3.0 EXECUTION

3.1 MANUFACTURER'S INSTRUCTIONS

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

3.2 INSTALLATION

- .1 Install cables in trenches and in ducts in accordance with Section 26 05 43.01 - Installation of Cables in Trenches and in Ducts.
- .2 Allow adequate conductor length for connection to supply by power supply authority.
- .3 Allow adequate conductor length for connection to service equipment.
- .4 Make grounding connections in accordance with Section 26 05 28 - Grounding - Secondary.
- .5 Provide concrete encasement in accordance with CSA A23.1 and as indicated on drawings.
- .6 Install pulling irons as required.
- .7 Seal ducts and conduits at building entrance location after installation of cable.

3.3 FIELD QUALITY CONTROL

- .1 Perform tests in accordance with Section 26 05 00 - Common Work Results – Electrical.
- .2 Perform additional tests as required by authority having jurisdiction.
- .3 Submit written test results for review and approval.



3.4 CLEANING

- .1 Proceed in accordance with Section 01 74 00 – Cleaning.
- .2 On completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION