

Tender 319-2026

Part 1 General

1.1 ADMINISTRATIVE

- .1 Submit to Contract Administrator submittals listed for review in accordance with the Specifications, or as requested by the Contract Administrator.
- .2 Submit promptly and in orderly sequence to not cause delay in Work. Failure to submit in ample time is not considered sufficient reason for extension of Contract Time and no claim for extension by reason of such default will be allowed.
 - .1 Allow 10 Working Days for review of submittals by the Contract Administrator.
- .3 Do not proceed with Work affected by submittal until review is complete.
- .4 Present shop drawings, product data, samples and mock-ups in SI Metric units.
- .5 Where items or information is not produced in SI Metric units converted values are acceptable.
- .6 Review submittals prior to submission to Contract Administrator. This review represents that necessary requirements have been determined and verified, or will be, and that each submittal has been checked and co-ordinated with requirements of Work and Contract Documents. Submittals not stamped, signed, dated and identified as to specific project will be returned without being examined and considered rejected.
- .7 Notify Contract Administrator, in writing at time of submission for review, identifying deviations from requirements of Contract Documents stating reasons for deviations.
- .8 Verify:
 - .1 Field measurements
 - .2 Field construction criteria
 - .3 Catalogue numbers and similar data
 - .4 Ensure affected adjacent Work is co-ordinated.
- .9 Contractor's responsibility for errors and omissions in submission is not relieved by Contract Administrator's review of submittals.
- .10 Contractor's responsibility for deviations in submission from requirements of Contract Documents is not relieved by Contract Administrator review.
- .11 Acceptance of Shop Drawings for a component or a subassembly does not constitute acceptance of the complete assembly of which it is a part.
- .12 The Contractor shall make any corrections required by the Contract Administrator and shall resubmit the required number of corrected copies of Shop Drawings. The Contractor shall direct specific attention in writing or on resubmitted Shop Drawings to revisions other than the corrections requested by the Contract Administrator on previous submission.

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- .13 After Contract Administrator's review and return of copies, distribute copies to sub-trades as appropriate.
- .14 Keep one reviewed copy of each submission on site.

1.2 SHOP DRAWINGS AND PRODUCT DATA

- .1 The term "shop drawings" means drawings, diagrams, illustrations, schedules, performance charts, brochures and other data which are to be provided by Contractor to illustrate details of a portion of Work.
- .2 The Contractor shall arrange for the preparation of clearly identified Shop Drawings as specified or as the Contract Administrator may reasonably request. Shop Drawings are to clearly indicate materials, weights, dimensions, methods of construction and attachment or anchorage, erection diagrams, connections, explanatory notes and other information necessary for completion of the Work. Where articles or equipment attach or connect to other articles or equipment, clearly indicate that all such attachments and connections have been properly coordinated, regardless of the trade under which the adjacent articles or equipment will be supplied and installed. Shop Drawings are to indicate their relationship to design Drawings and Specifications. Notify the Contract Administrator in writing of any deviations in Shop Drawings from the requirements of the Contract Documents.
- .3 Have Shop Drawings stamped, signed and dated by a Professional Engineer licensed to practice in the Province of Manitoba where required in the Specifications or by the Contract Administrator.
- .4 The Contractor shall examine all Shop Drawings prior to submission to the Contract Administrator to ensure that all necessary requirements have been determined and verified and that each Shop Drawing has been checked and coordinated with the requirements of the Work and the Contract Documents.
- .5 Submittals shall be in one of the following formats:
 - .1 Submit one electronic PDF copy.
- .6 Shop Drawing reviews by the Contract Administrator is solely to ascertain conformance with the general design concept. Responsibility for approval of detail design inherent in Shop Drawings rests with the Contractor and review by the Contract Administrator shall not imply such approval.
- .7 Shop Drawings will be returned to the Contractor with one of the following notations:
 - .1 When stamped "REVIEWED" or "NO EXCEPTIONS TAKEN", distribute additional copies as required for execution of the Work.
 - .2 When stamped "REVIEWED AS MODIFIED" or "MAKE NOTED CORRECTIONS", ensure that all copies for use are modified and distributed, same as specified for "REVIEWED".
 - .3 When stamped "REVISE AND RESUBMIT", make the necessary revisions, as indicated, consistent with the Contract Documents and submit again for review.
 - .4 When stamped "NOT REVIEWED" or "REJECTED", submit other Drawings, brochures, etc., for review consistent with the Contract Documents.

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- .5 Only Shop Drawings bearing "REVIEWED", "NO EXCEPTIONS TAKEN", "MAKE NOTED CORRECTIONS", or "REVIEWED AS MODIFIED" shall be used on the Work unless otherwise authorized by the Contract Administrator.
- .8 After submittals are stamped "REVIEWED", "NO EXCEPTIONS TAKEN", "MAKE NOTED CORRECTIONS" or "REVIEWED AS MODIFIED", no further revisions are permitted unless re-submitted to the Contract Administrator for further review.
- .9 Any adjustments made on Shop Drawings by the Contract Administrator are not intended to change the Contract Price. If it is deemed that such adjustments affect the Contract Price, clearly state as such in writing prior to proceeding with fabrication and installation of Work.
- .10 Make changes in Shop Drawings, which the Contract Administrator may require, consistent with Contract Documents. When re-submitting, notify the Contract Administrator in writing of any revisions other than those requested by the Contract Administrator.
- .11 Only two (2) reviews of Shop Drawings will be made by the Contract Administrator at no cost. Each additional review will be charged to the Contractor at the Contract Administrator's scheduled rates. The Contract Administrator's charges for the additional Work will be deducted from the Contractor's Progress Certificates.
- .12 Show the following information in lower right hand corner of shop drawings.
 - .1 Project Title.
 - .2 Tender number or other project number assigned by the Contract Administrator.
 - .3 Name of the depicted item in accordance with the Specifications and Drawings.
 - .4 Project series number and location where the item is used if applicable.
 - .5 Specification section number if applicable
 - .6 Proposed option if applicable.
 - .7 Name of Contractor.
- .13 Accompany submissions with transmittal letter, containing:
 - .1 Date.
 - .2 Project title and number.
 - .3 Contractor's name and address.
 - .4 Identification and quantity of each shop drawing, product data and sample.
 - .5 Specification Section, Title, Number, and Clause
 - .6 Other pertinent data.
 - .7 Date and revision dates.
 - .8 Project title and Bid Opportunity number.
 - .9 Name of:
 - .1 Contractor
 - .2 Subcontractor
 - .3 Supplier
 - .4 Manufacturer
 - .5 Separate detailer when pertinent

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- .10 Identification of product of material.
- .11 Relation to adjacent structure or materials.
- .12 Field dimensions, clearly identified as such.
- .13 Specification section name, number and clause number or drawing number and detail/section number.
- .14 Applicable standards, such as CSA or CGSB numbers.
- .15 Contractor's stamp, initialled or signed, certifying review of submission, verification of field measurements and compliance with Contract Documents.

1.3 PROCEDURES

- .1 The Contractor shall, if required by the Contract Administrator, submit for the review of the Contract Administrator method statements which describe in detail, supplement with Drawings where necessary, the methods to be adopted for executing any portion of Work.
- .2 These statements shall also include details of constructional plant and labour to be employed. Acceptance by the Contract Administrator shall not relieve the Contractor of any of his responsibilities, nor shall reasonable refusal to approve entitle the Contractor to extra payment or an extension of time.
- .3 Other Considerations
 - .1 Fabrication, erection, installation or commissioning may require modifications to equipment or systems to conform to the design intent. Revise pertinent shop drawings and resubmit.
 - .2 Material and equipment delivered to the site of the works will not be paid for at least until pertinent shop drawings have been submitted and reviewed.
 - .3 Incomplete shop drawing information will be considered as stipulated deductions for the purposes of progress payment certificates.
 - .4 No delay or cost claims will be allowed that arise because of delays in submissions, re-submissions and review of shop drawings.

Part 2 Products

2.1 NOT USED

- .1 Not Used.

Part 3 Execution

3.1 NOT USED

- .1 Not Used.

END OF SECTION

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Part 1 General

1.1 INSPECTION

- .1 Allow Contract Administrator access to Work. If part of Work is in preparation at locations other than Place of Work, allow access to such Work whenever it is in progress.
- .2 Give timely notice requesting inspection if Work is designated for special tests, inspections or approvals by Contract Administrator instructions, or law of Place of Work.
- .3 If Contractor covers or permits to be covered Work that has been designated for special tests, inspections or approvals before such is made, uncover such Work, have inspections or tests satisfactorily completed and make good such Work.
- .4 The Contract Administrator will order part of Work to be examined if Work is suspected to be not in accordance with Contract Documents. If, upon examination such work is found not in accordance with Contract Documents, correct such Work and pay cost of examination and correction. If such Work is found in accordance with Contract Documents, the City shall pay cost of examination and replacement.

1.2 INDEPENDENT INSPECTION AGENCIES

- .1 Independent Inspection/Testing Agencies may be engaged by the City for purpose of inspecting and/or testing portions of Work. Cost of such services will be borne by the City. Costs of additional tests required due to defective Work shall be paid by the Contractor.
- .2 All equipment required for executing inspection and testing will be provided by the respective agencies.
- .3 Employment of inspection/testing agencies does not relieve or relax responsibility to perform Work in accordance with Contract Documents.
- .4 If defects are revealed during inspection and/or testing, appointed agency will request additional inspection and/or testing to ascertain full degree of defect. Correct defect and irregularities as advised by the Contract Administrator at no cost to the City. Pay costs for retesting and re-inspection.

1.3 ACCESS TO WORK

- .1 The City, the Contract Administrator, and other authorities having jurisdiction shall have access to the work.

1.4 REJECTED WORK

- .1 Remove defective Work, whether result of poor workmanship, use of defective products or damage and whether incorporated in Work or not, which has been rejected by the Contract Administrator as failing to conform to Contract Documents. Replace or re-execute in accordance with the Contract Documents.

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- .2 Make good other Contractor's work damaged by such removals or replacements promptly.
- .3 If in opinion of the Contract Administrator it is not expedient to correct defective Work or Work not performed in accordance with Contract Documents, the City will deduct from Contract Price difference in value between Work performed and that called for by Contract Documents, amount of which will be determined by Contract Administrator.

1.5 REPORTS

- .1 Submit draft inspection and test reports to Contract Administrator, prior to inclusion with the O&M manuals, in accordance with Section 01 33 00 - Submittal Procedures.

Part 2 Products

2.1 NOT USED

- .1 Not Used.

Part 3 Execution

3.1 NOT USED

- .1 Not Used.

END OF SECTION

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Part 1 General

1.1 SUBMITTALS

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

1.2 TEMPORARY DISCONNECTION OF 12.6 KV FEEDER FROM RANNOCK SUBSTATION TO WEWPCC 2500 KVA TRANSFORMER

- .1 Temporary disconnect overhead conductors to de-energize pole mounted equipment associate with feeder between Rannock Substation and WEWPCC 2500 kVA transformer, as well as maintain power to WEWPCC Outfall Building.
- .2 Reconnect existing overhead conductor to restore power to WEWPCC 2500kVA transformer.
- .3 **It is required that all power outages are kept to an absolute minimum, as these facilities are critical City infrastructure.**

1.3 TEMPORARY POWER AND LIGHT

- .1 Provide temporary power and light, construction power, lighting, and other requirements during shutdowns. The Flood Pumping / Lift Station are equipped with a high voltage service. The utility service provides 600V power within the Station via the step-down transformers. It is anticipated that the utility service (and thus the 600V distribution) will be unavailable during a brief period when the high voltage services are terminated at the incoming main switchgear and subsequently when the outgoing high voltage cable is routed into the step-down transformer.
- .2 If 600V / 120V / 208V power is required by the Contractor then the Contractor may coordinate with, and pay for temporary power to be brought to the site. Where a temporary 600V service is used, the Contractor is responsible for providing a service entrance rated fusible disconnect switch or circuit breaker, a utility metering enclosure, and the 600V distribution. All costs are to be paid for by the Contractor. As an alternative to a temporary 600V service the Contractor may provide a temporary 600V generator, and all fuel costs are paid for by the Contractor. Provision of 600V power by the Contractor is mandatory during utility de-energization of the site. **It is required that all power outages are kept to an absolute minimum, as these facilities are critical City infrastructure.**
- .3 The existing Station lighting and receptacles may be used for construction requirements. Correct and repair any damage to existing electrical distribution, lighting, and receptacles, caused by use under this Contract.

1.4 FIRE PROTECTION

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

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Part 2 Products

2.1 NOT USED

.1 Not Used.

Part 3 Execution

3.1 NOT USED

.1 Not Used.

END OF SECTION

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Part 1 General

1.1 INSTALLATION AND REMOVAL

- .1 Prepare site plan indicating proposed location and dimensions of area to be used by Contractor, number of trailers to be used (if needed), avenues of ingress/egress to fenced area and details of fence installation.
- .2 Indicate use of supplemental or other staging area.
- .3 Provide construction facilities in order to execute work expeditiously.
- .4 Remove from site all such work after use.

1.2 SCAFFOLDING

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

1.3 HOISTING

- .1 Provide, operate and maintain any hoists required for moving of workers, materials and equipment. Make financial arrangements with Subcontractors for their use of hoists.
- .2 Hoists to be operated by qualified operator.

1.4 CONSTRUCTION PARKING

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

1.5 EQUIPMENT, TOOL AND MATERIALS STORAGE

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

1.6 SANITARY FACILITIES

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

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1.7 OFFICES

- .1 Provide office heated to 20 degrees C, lighted, and ventilated, of sufficient size to accommodate site meetings and furnished with drawing laydown table.
- .2 Provide marked and fully stocked first-aid case in a readily available location at the construction sites.
- .3 Subcontractors to provide their own offices as necessary. Direct location of these offices.

1.8 LAYDOWN AND STORAGE

- .1 All construction materials shall be stored at designated storage areas. Stored combustible materials shall be separated by clear space to prevent fire spread and allow access for manual fire fighting equipment, including fire hoses, extinguishers, hydrants, etc.
- .2 Ensure equipment is stored in a secure manner.
- .3 Pressurized dry chemical fire extinguishers of suitable capacity or equally effective extinguishers as per NFPA 10 shall be provided where:
 - .1 Flammable liquids are stored or handled.
 - .2 Welding or flame cutting is performed.

1.9 DISPOSAL OF WASTE MATERIALS

- .1 Spoiled and waste materials shall not be dumped, under any circumstances, in any locations other than those approved by the local authorities. Any cost for permits and fees for disposing of waste materials shall be at the Contractor's expense.
- .2 Disposal of all excavated and waste materials shall be in accordance with the requirements of the appropriate provincial regulatory agencies.
- .3 When working anywhere within the Works the Contractor shall at the end of each working day remove the rubbish and leave the Site in a clean and tidy state, to the satisfaction of the Contract Administrator. If this is not done, the City will clean the Site and charge the Contractor.

1.10 WARNINGS AND TRAFFIC SIGNS

- .1 When Work is performed within public areas, provide and erect adequate warning signs as necessary to give proper warning. Place signs sufficiently in advance to enable public to respond to directions.

1.11 Provide and maintain signs and other devices required to indicate construction activities or other temporary or unusual conditions resulting from the Work.

Part 2 Products

- .1 Not Used.

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Part 3 Execution

.1 Not Used.

END OF SECTION

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Part 1 General

1.1 REFERENCES

- .1 Conform to reference standards, in whole or in part as specifically requested in specifications.
- .2 If there is question as to whether products or systems are in conformance with applicable standards, the Contract Administrator reserves the right to have such products or systems tested to prove or disprove conformance.
- .3 Cost for such testing will be born by the City in event of conformance with Contract Documents or by the Contractor in event of non-conformance.

1.2 QUALITY

- .1 Products, materials, equipment and articles incorporated in Work shall be new, not damaged or defective, and of best quality for purpose intended. If requested, furnish evidence as to type, source and quality of products provided.
- .2 Defective products, whenever identified prior to completion of Work, will be rejected, regardless of previous inspections. Inspection does not relieve responsibility, but is precaution against oversight or error. Remove and replace defective products at own expense and be responsible for delays and expenses caused by rejection. Should disputes arise as to quality or fitness of products, decision rests strictly with the Contract Administrator based upon requirements of Contract Documents.
- .3 Unless otherwise indicated in specifications, maintain uniformity of manufacture for any particular or like item throughout building.

1.3 AVAILABILITY

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

1.4 METRIC PROJECT

- .1 Unless otherwise noted, this project has been designed and is to be constructed in the International System (SI) of Units metric system of measurements.
- .2 During construction, when specified metric elements are unattainable at the time they are required to meet the construction schedule, the Contractor shall notify the Contract Administrator in writing and suggest alternative substitutions. Costs due to these substitutions shall be borne by the Contractor.

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1.5 STORAGE, HANDLING AND PROTECTION

- .1 Handle and store products in manner to prevent damage, adulteration, deterioration and soiling and in accordance with manufacturer's instructions when applicable.
- .2 Store packaged or bundled products in original and undamaged condition with manufacturer's seal and labels intact. Do not remove from packaging or bundling until required in Work.
- .3 Store products subject to damage from weather in weatherproof enclosures.
- .4 Store cementitious products clear of earth or concrete floors, and away from walls.
- .5 Keep sand, when used for grout or mortar materials, clean and dry. Store sand on wooden platforms and cover with waterproof tarpaulins during inclement weather.
- .6 Store sheet materials, lumber and similar products on flat, solid supports and keep clear of ground. Slope to shed moisture.
- .7 Store and mix paints in heated and ventilated room. Remove oily rags and other combustible debris from site daily. Take every precaution necessary to prevent spontaneous combustion.
- .8 Remove and replace damaged products at own expense and to satisfaction of the Contract Administrator.
- .9 Touch-up damaged factory finished surfaces to Contract Administrator's satisfaction. Use touch-up materials to match original. Do not paint over name plates.

1.6 TRANSPORTATION

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

1.7 MANUFACTURER'S INSTRUCTIONS

- .1 Unless otherwise indicated in specifications, install or erect products in accordance with manufacturer's instructions. Do not rely on labels or enclosures provided with products. Obtain written instructions directly from manufacturers.
- .2 Notify the Contract Administrator in writing, of conflicts between specifications and manufacturer's instructions, so that the Contract Administrator will establish the course of action.
- .3 Improper installation or erection of products, due to failure in complying with these requirements, authorizes the Contract Administrator to require removal and re-installation at no increase in Contract Price or Contract Time.

1.8 REMEDIAL WORK

- .1 Perform remedial work required to repair or replace parts or portions of Work identified as defective or unacceptable. Co-ordinate adjacent affected Work as required.

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- .2 Perform remedial work by specialists familiar with materials affected. Perform in a manner to neither damage nor put at risk any portion of Work.

1.9 FASTENINGS

- .1 Provide metal fastenings and accessories in same texture, colour and finish as adjacent materials, unless indicated otherwise.
- .2 Prevent electrolytic action between dissimilar metals and materials.
- .3 Use non-corrosive hot dip galvanized steel fasteners and anchors for securing exterior work, unless stainless steel or other material is specifically requested in affected specification Section.
- .4 Space anchors within individual load limit or shear capacity and ensure they provide positive permanent anchorage. Wood, or any other organic material plugs are not acceptable.
- .5 Keep exposed fastenings to a minimum, space evenly and install neatly.
- .6 Fastenings which cause spalling or cracking of material to which anchorage is made are not acceptable.

1.10 PROTECTION OF WORK IN PROGRESS

- .1 Prevent un-authorized access to work areas via fencing of work areas.
- .2 Do not cut, drill or sleeve load bearing structural member, unless specifically indicated without written approval of the Contract Administrator.

Part 2 Products

2.1 NOT USED

- .1 Not Used.

Part 3 Execution

3.1 WORKMANSHIP

- .1 Ensure Quality of Work is of highest standard, executed by workers experienced and skilled in respective duties for which they are employed. Immediately notify the Contract Administrator if required Work is such as to make it impractical to produce required results.
- .2 Do not employ anyone unskilled in their required duties. The Contract Administrator reserves the right to require dismissal from site, workers deemed incompetent or careless.
- .3 Decisions as to standard or fitness of Quality of Work in cases of dispute rest solely with the Contract Administrator, whose decision is final.

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END OF SECTION

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Part 1 General

1.1 SUBMITTALS

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

1.2 MATERIALS

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

1.3 PREPARATION

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

1.4 EXECUTION

- .1 Remove and replace defective and non-conforming Work.

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- .2 Provide openings in non-structural elements of Work for penetrations of electrical Work.
- .3 Execute Work by methods to avoid damage to other Work, and which will provide proper surfaces to receive patching and finishing.
- .4 Cut rigid materials using masonry saw or core drill. Pneumatic or impact tools not allowed on masonry work without prior approval.
- .5 Restore work with new products in accordance with requirements of Contract Documents.
- .6 Fit Work airtight to pipes, sleeves, ducts, conduit, and other penetrations through surfaces.
- .7 At penetration of fire rated wall, ceiling, or floor construction, completely seal voids with approved fire stopping material, full thickness of the construction element.
- .8 Refinish surfaces to match adjacent finishes: Refinish continuous surfaces to nearest intersection. Refinish assemblies by refinishing entire unit.

Part 2 Products

2.1 NOT USED

- .1 Not Used.

Part 3 Execution

3.1 NOT USED

- .1 Not Used.

END OF SECTION

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Part 1 General

1.1 PROJECT CLEANLINESS

- .1 Maintain work in tidy condition, free from accumulation of waste products and debris, other than that caused by the City or other Contractors.
- .2 Remove waste materials from site at daily regularly scheduled times or dispose of as directed by the Contract Administrator. Do not burn waste materials on site.
- .3 Clear snow and ice from access to building, bank/pile snow in designated areas only.
- .4 Make arrangements with and obtain permits from authorities having jurisdiction for disposal of waste and debris.
- .5 Provide on-site containers for collection of waste materials and debris.
- .6 Dispose of waste materials and debris off site.
- .7 Clean interior areas prior to start of finishing work, and maintain areas free of dust and other contaminants during finishing operations.
- .8 Store volatile waste in covered metal containers, and remove from premises at end of each working day.
- .9 Provide adequate ventilation during use of volatile or noxious substances. Use of building ventilation systems is not permitted for this purpose.
- .10 Use only cleaning materials recommended by manufacturer of surface to be cleaned, and as recommended by cleaning material manufacturer.
- .11 Schedule cleaning operations so that resulting dust, debris and other contaminants will not fall on wet, newly painted surfaces nor contaminate building systems.

Part 2 Products

2.1 NOT USED

- .1 Not Used.

Part 3 Execution

3.1 NOT USED

- .1 Not Used.

END OF SECTION

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Part 1 General

1.1 SUBMITTALS

- .1 Submittals: in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Copy will be returned after final inspection, with Contract Administrator's comments.
- .3 Revise content of documents as required prior to final submittal.
- .4 Furnish evidence, if requested, for type, source and quality of products provided.
- .5 Pay costs of transportation.

1.2 OPERATING AND MAINTENANCE MANUALS

- .1 Prepare using personnel experienced in maintenance and operation of described products.
- .2 Operation and maintenance instructions and technical data to be sufficiently detailed with respect to design elements, construction features, component function, correct installation procedure and maintenance requirements, to permit effective start-up, operation, maintenance, repair, modification, extension and expansion of any portion or feature of installation. Technical data to be in form of approved shop drawings, product data, supplemented by bulletins, component illustrations, exploded views, technical descriptions of items, and parts lists.
- .3 One (1) advance copy of the manual shall be submitted prior to Total Performance of the Work for review and comments. After review, five (5) hard copies and one electronic (PDF) copy of the final manuals shall be submitted.
- .4 For the guidance of the City's operating and maintenance personnel, the Contractor shall prepare O&M Manuals for the Work, describing in detail the construction of each part of the Work and the recommended procedure for operation, servicing and maintenance.
- .5 All instructions in these manuals shall be in simple language to guide the City in the proper operating and maintenance of this installation.
- .6 In addition to information called for in the Specifications, include the following:
 - .1 Overall Title sheet, labelled "Operation and Maintenance Instructions", and containing project name and date, facility's covered in the manual, City's Contract number, the name and address of the Contractor, and the issue date.
 - .2 Overall list of contents, indicating the facilities upgraded by the project.
 - .3 Title sheet for each section, labelled "Operation and Maintenance Instructions", the applicable facility, and containing project name and date.
 - .4 List of contents for each section.
 - .5 Include:
 - .1 Brochures/catalogue excerpts of all components of the Work.
 - .2 Documentation of all test results.
 - .3 Complete set of equipment and assembly drawings
 - .4 Installation, start-up, O&M Manuals
 - .5 Any specific requirements from the Specifications

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- .6 Clean Shop Drawings and cutsheets of all equipment and materials,
 - .1 Do not utilize the submittals as these may have markups on them and would therefore contain inaccurate information.
- .7 Include sections for the record drawings of all installations. Drafted record drawings of size 432x279mm (11 x 17") will be inserted by the Contract Administrator, based on the record drawings marked up by the Contractor.
- .8 Names, addresses, and telephone numbers of all major sub-contractors and suppliers.
- .7 Modify and supplement the manual as required by the Contract Administrator.
- .8 Format to be as follows:
 - .1 Binders: vinyl, hard covered, 3 'D' ring, with spine and face pockets.
 - .2 When multiple binders are used correlate data into related consistent groupings. Identify contents of each binder on spine.
 - .3 Drawings: provide with reinforced punched binder tab. Bind in with text; fold larger drawings to size of text pages.

1.3 AS-BUILT DRAWINGS

- .1 After award of Contract, the Contract Administrator will provide a complete set of Drawings for the purpose of maintaining Project As-Built Drawings. Accurately record deviations from Contract Documents caused by Site conditions and changes ordered by the Contract Administrator. Update daily.
- .2 Identify Drawings as "Project Record Copy". Maintain in good condition and make available for inspection on-site by Contract Administrator at all times.
- .3 On completion of each facility, submit As-Built Drawings to Contract Administrator for review.

Part 2 Products

2.1 NOT USED

- .1 Not Used.

Part 3 Execution

3.1 NOT USED

- .1 Not Used.

END OF SECTION

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Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Requirements specified within this section apply to all sections in Division 26, Electrical. This section supplements requirements of other Divisions.

1.2 REFERENCE STANDARDS

- .1 Manitoba Building Code (MBC).
- .2 The Winnipeg Electrical By-law (WEB)
- .3 CSA C22.1 Canadian Electrical Code - Part 1 (CEC)
- .4 CSA C22.2 No. 0 General Requirements - Canadian Electrical Code - Part 2
- .5 CAN3-C235 Preferred Voltage Levels for AC Systems, 0-50,000 V
- .6 Electrical and Electronic Manufacturers Association of Canada (EEMAC)
- .7 National Electrical Manufacturers Association (NEMA)
- .8 Institute of the Electrical and Electronic Engineers (IEEE)
- .9 Insulated Cable Engineers Association (ICEA)
- .10 Canadian Standards Association (CSA)
- .11 Underwriters Laboratories Canada (ULC)
- .12 American National Standards Institute (ANSI)
- .13 National Fire Protection Agency (NFPA)
- .14 Comply with the most current locally enforced edition of CSA C22.1 Canadian Electrical Code - Part 1, Winnipeg Electrical By-law, Provincial Safety Electrical Authority Codes and Bulletins.
- .15 Comply with all laws, ordinances, rules, regulations, codes, and orders of all authorities having jurisdiction relating to this Work. Where these regulations conflict, comply with the most stringent condition.
- .16 Comply with latest editions of the CSA Certification Standards and Bulletins.

1.3 DRAWINGS AND SPECIFICATIONS

- .1 All materials, equipment, labor, work denoted on the Drawing set is to be considered as new work, to be provided by the Contractor unless specifically noted otherwise. Some of the electrical Drawings show existing systems (with modifications to these systems). These Drawings specifically indicated that there are existing systems shown. Where Drawings do not specifically indicate that existing systems are depicted, the Contractor shall assume that the materials, equipment, labor, work indicated will form part of his scope, and the Contractor shall include all costs (including materials, labor, etc) to perform the work.
- .2 Prior to installing power and control cabling, the Contractor shall review the equipment Shop Drawings, and to ensure that cabling requirements are understood. There may be variations in wiring requirements, that may require alternate wiring requirements from

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that shown on the Drawings. Include such wiring and connections in tender at no additional costs.

- .3 The electrical Drawings in some cases indicate the size of cables, breakers, conduits, etc. These sizes are based on the supply of specific sizes of equipment. For cases where the Contractor supplies equipment that varies from these assumptions it is the responsibility of the Contractor to provide the correct size of breaker, cable, etc to suit the installation, at no additional cost to the Contract.
- .4 The intent of the Drawings and Specifications is to indicate labor, products, and services necessary for a complete, installed, tested, commissioned and functional installation.
- .5 Electrical Drawings may indicate approximate route to be followed by conduits and cables and general location of electrical equipment. They do not show all structural, architectural and mechanical details. In some cases, conduit or wiring is only shown diagrammatically on the Drawings. The details on exact cable or conduit routing, and exact equipment installation location is to be determined on site and coordinated with all other trades.
- .6 Where circuit numbers are shown adjacent to equipment, the Electrical Contractor shall provide all wiring, conduit, supports, and any other requirements to provide power to that piece of equipment from the circuit indicated. Where circuit numbers are not shown adjacent to a piece of equipment, refer to the single line drawings for connections details. Provide all wiring, conduit, supports, and any other requirements to provide power to that piece of equipment.
- .7 These Specifications along with the Drawings and Specifications of all other divisions shall be considered as an integral part of the Drawing package. Any item or subject omitted from the Specifications or the Drawings but which is mentioned or reasonably specified in the Drawings or Specifications of other divisions, shall be considered as properly and sufficiently specified and shall be provided.
- .8 If discrepancies or omissions in the Drawings or Specifications are found, or if the intent or meaning is not clear, advise the Contract Administrator for clarification before submitting a bid.
- .9 Provide all minor items and work not shown or specified but which are reasonably necessary to complete the work.
- .10 Various package unit types of equipment are included in the work. It is the responsibility of the Contractor to familiarize himself with the requirements of the equipment vendor, and to include all materials and labor for a complete and working installation. In some cases this means that motors, valves, actuators, etc need to be wired and connected in the field. The Contractor shall include all costs to perform such services as part of his tender submittal. Coordination between the equipment vendor and the Contractor shall be performed prior to tender bid closing date, and all costs shall be included in the tender. Request for extras due to lack of coordination between the Contractor and the equipment vendors will not be accepted.
- .11 Cables schedules / lists where shown do not include all cables required to perform the complete Facility installation. They shall be used as a general guide. Accurate cable lists, quantities, take-offs remain the responsibility of the Contractor. Cable schedules

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only show cabling where specific cable tags are available on the Drawings. Refer to the cable schedule for specific systems which are not included on the schedule, and include materials, and installation for all remaining cabling.

1.4 CARE, OPERATION AND START-UP

- .1 Instruct the Contract Administrator's maintenance and operating personnel in the operation, care and maintenance of systems, system equipment and components.
- .2 Where services of a Manufacturer's Factory Service Engineer is required, arrange and pay for services to supervise start-up of installation, check, adjust, balance and calibrate components and instruct operating personnel.
- .3 Provide factory service engineer support for such a period, and for as many visits as necessary to put equipment in operation, and ensure that operating personnel are familiar and fully trained with all aspects of its care and operation.

1.5 PERMITS, FEES AND INSPECTION

- .1 The Contract Administrator will submit to Electrical Inspection Department and Supply Authority necessary number of Drawings and Specifications for examination and approval prior to commencement of work.
- .2 The Contractor shall pay associated fees as required by the Electrical Inspections and Permitting department.
- .3 Notify the Contract Administrator of changes required by Electrical Inspection Department prior to making changes.
- .4 Furnish a Certificate of Final Inspection and approvals from inspection authority to the Contract Administrator.

1.6 DEFINITIONS

- .1 The following are definitions used in Division 26.
 - .1 Inspection Authority means agent of any authority having jurisdiction over construction and safety standards associated with any part of electrical site work.
 - .2 Supply Authority or Supply Utility means electrical power company or commission responsible for delivering electrical power to the project site.
 - .3 Electrical Code or Code means the Electrical Code in force at the project location.
 - .4 CEC means Canadian Electrical Code (latest edition being enforced by law).
 - .5 Contractor and Electrical Contractor means the entity retained to perform the work listed herein.
 - .6 Contract Administrator means the person with the authority to make decisions and administer the Contract on behalf of the City.
 - .7 Provide means to supply, install, wire, connect, test, commission and leave in complete and working order.

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- .8 The term “Shop Drawing” means Drawings, diagrams, illustrations, schedules, performance characteristics, brochures and other data, which are to be provided by the Contractor to illustrate details of a portion of the work.

1.7 DESIGN REQUIREMENTS

- .1 Design equipment, anchorage, and support systems for vertical and lateral loading in accordance with MBC.
- .2 Operating voltages to be within those defined in CAN3-C235.
- .3 Verify before energization that equipment supplied under this Contract is compatible with the site electrical power supply system.
- .4 All equipment, devices and installation methods (even where not specifically expressed on the Drawings) shall comply with all applicable codes and standards.

1.8 ELECTRICAL COORDINATION

- .1 Coordinate work with all other trades to ensure that conflicts do not occur.
- .2 Coordinate work with utilities where appropriate, including but not limited to:
 - .1 Incoming overhead lines,
 - .2 Underground buried services,
 - .3 Transformer(s) supplying main electrical service to the Facility,
 - .4 Installation of Supply Authority meter,
 - .5 Installation of incoming telephone / data communication service conductors or cables.

1.9 SUBMITTALS

- .1 Permits, Fees and Inspection:
 - .1 Furnish copies of all inspection reports and Certificate of Final Acceptance from Electrical Inspection Authority and any authorities having jurisdiction on completion of work to Contract Administrator and include copies in the O & M manuals.
- .2 Site Documentation
 - .1 In each electrical room, provide power distribution system single line diagrams in glazed metal frames.
 - .2 Where work includes modification to existing power distribution or fire alarm systems, provide new single line and riser diagrams showing complete modified system. Reinstall diagram into existing frames where feasible or provide new frame and glazing.
- .3 Within 15 days of award of the Contract, the Contractor shall submit a completed equipment procurement schedule, which lists the Manufacturer and model of equipment, indicating the projected ordering, Shop Drawing submittal date and delivery dates of all products to meet the required construction schedule.

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- .4 Prior to delivery of any products to the job site and sufficiently in advance of requirements to allow ample time for checking, submit Shop Drawings for review as specified in Division 01.
- .5 Submit Shop Drawings (including product data) for all equipment as required in each section of this Specification.
- .6 Prior to submitting the Shop Drawings to the Contract Administrator, the Contractor shall review, date and sign the Shop Drawings to determine that the equipment complies with the requirements of the Specifications and Drawings.
- .7 Shop Drawings shall indicate materials, methods of construction and attachment of support, wiring diagrams, connections, recommended installation details, explanatory notes and other information necessary for completion of the work. Where equipment is connected to other equipment, indicate that such items have been coordinated, regardless of the section under which the adjacent items will be supplied and installed. Indicate cross-references to design Drawings and Specifications. Adjustments made on Shop Drawings by the Contract Administrator are not intended to change the Contract price. If adjustments affect the value of the work, state so in writing to the Contract Administrator prior to proceeding with the work.
- .8 Manufacture of products shall conform to the revised Shop Drawings. Failure to supply a product based on the revised, marked up Shop Drawings may require on site product revisions or modifications, which will be at the cost of the Contractor.
- .9 Keep one (1) complete set of Shop Drawings at job Site during construction.
- .10 Prior to shipping pre-fabricated control panels, photos of completed panels shall be sent to the Contract Administrator of final review. The resolution of the photos should be such that individual wire tags can be read.
- .11 Shop Drawings shall have the specific equipment numbers on all pages to clearly indicate which piece of equipment the Shop Drawing refers to. In addition, the entire product part number or catalog number should be adjacent to the tag.

1.10 AS-BUILT DRAWINGS

- .1 Refer to Section 01 78 00, Closeout Procedures - for additional requirements for as-built drawings.
- .2 The Contractor shall keep one (1) complete set of white prints at the site during work, including all addenda, change orders, site instructions, clarifications, and revisions for the purpose of As-Built drawings. As the work on-site proceeds, the Contractor shall clearly record in red pencil all as-built conditions, which deviate from the original Contract Documents. As-Built drawings to include circuiting of all devices, conduit and feeder runs (complete with conductor size and number) and locations of all electrical equipment.
- .3 On completion of the work, minimum of four (4) weeks prior to final inspection, submit As-Built drawings to Contract Administrator for review. The Contractor shall certify, in writing signed and dated, that the As-Built drawings are complete and that they accurately indicate all electrical services, including exposed as well as concealed items.
- .4 Comply with all other City of Winnipeg standards and requirements.

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1.11 OPERATIONS AND MAINTENANCE (O & M) MANUALS

- .1 Provide operation and maintenance manuals as specified herein and in accordance with the general conditions.
- .2 Include in the operations and maintenance manuals a minimum of:
 - .1 Cover page including project name, year, name of owner and electrical consultant. Cover page shall be enclosed in a clear plastic cover.
 - .2 Index.
 - .3 List of manufacturers and supplier for all items.
 - .4 Names, address and phone number of all local suppliers for items included in maintenance manual.
 - .5 Stamped and signed Shop Drawings.
 - .6 Details of design elements, construction features, component function and maintenance requirements, to permit effective start-up, operation, maintenance, repair, modification, extension and expansion of portions or features of the installation.
 - .7 Technical data, product data, supplemented by bulletins, component illustrations, exploded views, technical descriptions of items and parts lists. Advertising or sales literature not acceptable.
 - .8 All test results performed. This includes, but is not limited to grounding system tests, operation tests, cable tests, Hi Pot tests, Megger tests, factory tests of all major systems, etc. Submit test results on COW approved test sheets.
 - .9 Software copies of relay settings
 - .10 As-Built drawings.
 - .11 Signed and dated warranty certificate.
 - .12 Signed and dated approval by the local Electrical Inspections Department.
 - .13 All other requirements outlined in the Specifications.
- .3 Deliver to the Contract Administrator prior to the scheduled takeover date, five (5) sets of operation and maintenance manuals. Each operation and maintenance manual shall be contained within one or more three "D-ring" binder(s). Each binder shall be labeled directly on the front cover as well as the spine ("ELECTRICAL MAINTENANCE MANUAL – PROJECT NAME – YEAR"). Include memory sticks for required electronic media.
- .4 Index plastic divider tabs (with type inserts) shall be provided for each Specification section. Paper dividers, with plastic tabs and typed insertions will not be accepted.
- .5 Submit draft document prior to the start of Commissioning.
- .6 Comply with all other COW standards and requirements.

1.12 ENVIRONMENTAL CONDITIONS

- .1 Equipment and systems are to be rated to correctly operate in the environment in which they are to be installed.

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- .2 Exterior devices shall be rated to operate in an exterior environment with temperature range of -40 degrees C to +40 degrees C.

1.13 QUALITY ASSURANCE

- .1 Qualifications
 - .1 For work involving specialties, including, but not limited to, the installation of high voltage switchgear, high voltage cables, overhead pole lines, sound and intercommunication systems, fire alarm systems, lightning protection systems, equipment cathodic protection, grounding systems, instrumentation, controls, electronic access, security systems, fibre optics systems, etc. employ only workers fully trained, qualified and experienced in the aspects of such work.

Part 2 Products

2.1 ACCEPTED MATERIALS

- .1 Materials: approved by and bearing a CSA label. Where there is no alternative to supplying equipment or material that is not approved or certified as indicated, obtain and pay for special approvals from the Office of the Fire Commissioner, Inspection and Technical Services Manitoba.
- .2 Factory assemble control panels and component assemblies. Control panels to be CSA certified. Include current interrupting rating on the front panel. Shop Drawings for custom built control panels (which are not designed and sealed as part of the Issued for Construction documents) shall be signed and sealed by an engineer, registered in the Province of Manitoba.
- .3 Minimum enclosure type to be NEMA 12 unless otherwise specified. Refer to the Drawings and other Specification section for specific requirements.
- .4 Provide materials and equipment in accordance with Section 01 61 00, Common Product Requirements.

2.2 EQUIPMENT FINISH

- .1 Shop finish metal enclosure surfaces by application of rust resistant primer inside and outside, and at least two coats of finish enamel.

2.3 EQUIPMENT IDENTIFICATION

- .1 Identify electrical equipment with nameplates as described below.
- .2 Nameplates:
 - .1 Lamacoid, 3 mm thick plastic nameplates, mechanically attached with self tapping stainless steel screws, white face with black lettering. Note: "Sheet Metal Screws" or other sharp pointed screws are NOT acceptable.
 - .2 Sizes as follows:

NAMEPLATE SIZES

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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	40 x 90 mm	2 lines	8 mm high letters
Size 6	25 x 100 mm	1 line	12 mm high letters
Size 7	25 x 100 mm	2 lines	5 mm high letters
Size 8	35 x 100 mm	3 lines	5 mm high letters
Size 9	45 x 100 mm	4 lines	5 mm high letters
Size 10	75 x 160 mm	3 or 4 lines	8 mm high letters
Size 11	150 x 250 mm	3 or 4 lines	10 mm high letters

- .3 Wording on nameplates to be approved by Contract Administrator prior to manufacture.
- .4 Allow for average of fifty (50) letters per nameplate.
- .5 Identification to be in English.
- .6 Provide nameplates for the following, sizes as shown:
 - .1 Cabinets – Size 8
 - .2 Small Junction Boxes (150mm x 150mm or smaller) – Size 1
 - .3 Large Junction Boxes – Size 2
 - .4 Oil filled padmount transformers – Size 11

2.4 WIRING IDENTIFICATION

- .1 Identify wiring with permanent indelible identifying markings, either numbered or coloured plastic tapes, on both ends of phase conductors of feeders and branch circuit wiring.
- .2 Maintain phase sequence and colour coding throughout.
- .3 Colour code: to CSA C22.1.
- .4 Use colour coded wires in communication cables, matched throughout system.

2.5 CONDUIT AND CABLE IDENTIFICATION

- .1 Colour code conduits, boxes and cables.
- .2 Code with plastic tape or paint at points where conduit or cable enters wall, ceiling, or floor, and at 5 m intervals.
- .3 Colours: 38 mm wide prime colour and 19 mm wide auxiliary colours.

System	Prime Band	Aux. Band
Medium Voltage (>750 V)	Orange	
347/600 V	Yellow	
120/208/240 V Power	Black	
UPS 120/208/240 V Power	Black	Green
Control Wiring (120 V)	Black	Orange
Fire Alarm	Red	

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System	Prime Band	Aux. Band
Low Voltage Communication/General	Blue	
Low Voltage Control Wiring (<50 V)	Blue	Orange
Intrinsically Safe	Blue	White
Ground	Green	
Fibre Optic	Purple	

- .4 Cable Identification: Supply and install lamacoid type cable identification tags for all cables. Install identification tag at both ends.

Part 3 Execution

3.1 PREPARATION AND PROTECTION

- .1 Schedule expediting of materials and execution of work in conjunction with associated work of other trades in order to meet the required work schedule.
- .2 Post engraved warning signs to meet requirements of local bylaws, Inspection Authority and Contract Administrator.
- .3 Protect those working on or in vicinity of exposed electrically energized equipment from physical danger. Shield and mark live parts in accordance with local regulations. Indicate the appropriate voltage.
- .4 Arrange for installation of temporary doors, barriers and similar items for access to rooms and areas containing electrical equipment. Keep these doors locked at all times, except when under direct supervision.
- .5 Permanently identify with lamacoid nameplate, equipment energized from multiple power sources, noting voltages, power source locations, supply disconnect designations and grounding electrode location.

3.2 WARNING SIGNS

- .1 As specified and to meet the requirements of Electrical Inspection Department and the Contract Administrator.
- .2 Lamacoid 3 mm thick plastic engraving sheet, red face, white core, mechanically attached with self tapping screws, 20mm text.

3.3 MOUNTING HEIGHTS

- .1 Unless otherwise noted, or in contravention of codes and standards, mount equipment replacing existing equipment at the same height.
- .2 Mounting height of equipment is from finished ground to centerline of equipment unless specified or indicated otherwise.
- .3 If mounting height of equipment is not indicated, verify with the Contract Administrator before proceeding with the installation.

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3.4 LOCATION OF DEVICES

- .1 Allow for change of location of devices at no extra cost or credit, provided that the distance does not exceed 3000mm (10') from that shown on the Drawings, when the requirement is made known prior to installation.

3.5 CONDUIT AND CABLE INSTALLATION

- .1 Sleeves through concrete: schedule 40 galvanized steel pipe, sized for free passage of conduit.
- .2 For wall, partitions, and ceilings the sleeve ends shall be flush with the finish on both sides but for floors they shall extend 25 mm (1") above finished floor level.
- .3 Fire stop opening with ULC approved assembly for the installation conditions.
- .4 Provide a detailed proposed conduit routing plan to the Contract Administrator prior to proceeding with the installation of conduit.
- .5 If possible, avoid routing conduits through hazardous area.
- .6 Separate cables of different voltage levels when cables are installed parallel to each other.

3.6 CUTTING, PATCHING, DRILLING

- .1 Provide all cutting and patching as required.
- .2 Return exposed surfaces to an as-found condition.
- .3 Exercise care where cutting/drilling holes in existing concrete elements so as not to damage existing reinforcing, or any other systems run in the concrete.
 - .1 Locate reinforcing and other existing systems using ground penetrating radar, X-Ray or other suitable means. Mark out on the surface of the concrete the locations of rebar and all other systems.
 - .2 For all holes larger than 50mm passing through reinforced concrete, mark the location of the desired hole and all embedded systems. Obtain approval from the Contract Administrator prior to cutting.
- .4 Firestop and seal all penetrations.
- .5 Ensure that water ingress will not occur.
- .6 Provide expansion joints for penetrations where shifting can occur.

3.7 ANCHOR INSTALLATION

- .1 The Contractor shall exercise care where installing anchors into existing concrete elements so as not to damage existing reinforcing. All anchors shall be installed utilizing carbide tip drill bits. The existing reinforcing shall be located utilizing a reinforcing bar locator and marked out on the surface of the concrete. The drill holes shall be advanced to the required depth for installation of the anchors. Should reinforcement be encountered while drilling the hole shall be terminated and repositioned to clear the reinforcement. Do not use core bits that can easily intercept and damage/cut the reinforcing during drilling.

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3.8 FIELD QUALITY CONTROL

- .1 All electrical work to be carried out by qualified, licensed electricians or apprentices as per the conditions of the Provincial Act respecting manpower vocational training and qualification. Employees registered in a provincial apprentices program shall be permitted, under the direct supervision of a qualified licensed electrician, to perform specific tasks - the activities permitted shall be determined based on the level of training attained and the demonstration of ability to perform specific duties. A maximum of one apprentice is permitted per qualified electrician.
- .2 The work of this division to be carried out by a Contractor who holds a valid Master Electrical Contractor license as issued by the Province of Manitoba.
- .3 Furnish Manufacturer's certificate or letter confirming that entire installation as it pertains to each system has been installed to Manufacturer's instructions.

3.9 TESTS

- .1 Test and check electrical, instrumentation and control systems for correct operation and compliance with statutory and regulatory authority requirements.
- .2 Perform tests in presence of Contract Administrator. Log, tabulate, sign and include testing and Commissioning results in the O & M manuals.
- .3 Testing shall include, but not be limited to, the following:
 - .1 Overhead gang operated switches
 - .2 Fuse Holders
 - .3 Electrical power distribution systems.
 - .4 Wire and cable system.
 - .5 All other equipment and systems as indicated in the Drawings and Specifications.
- .4 Refer to appropriate Specification sections for specific system or equipment tests.
- .5 Supply instruments, meters, consumable parts (such as fuses) and equipment. Arrange for qualified personnel to conduct tests.
- .6 Correct systems which fail any test, correct and re-do tests to ensure proper operation of the system.

3.10 CHECKOUT AND STARTUP

- .1 Voltage Field Test:
 - .1 Refer to Section 26 08 05, Acceptance Testing as applicable.
 - .2 Check pad mounted transformer voltage at point of termination of supply conductors when installation is essentially complete and is in operation.
 - .3 Check voltage amplitude between phases, and phase to neutral for loaded and unloaded conditions.
 - .4 Check voltage drop on at all distribution panels, and ensure that it is less than 2 percent in accordance with CEC requirements.

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- .5 Check voltage drop on equipment loads, and ensure that total voltage drop from the service to the farthest device is less than 5 percent in accordance with the CEC. Adjust transformer taps, and upsize conductors as required to meet the CEC.
- .6 Unbalance Corrections:
- .7 Make written request to the Supply Utility to correct conditions if the service voltage unbalance exceeds 3 percent.
- .2 Current Field Tests:
 - .1 Make line current check after supply utility has made final adjustments to supply voltage.
 - .2 Check current balance at the service demarcation point. Adjust loads to ensure that each phase is appropriately balanced.
 - .3 Check line current in each phase for each piece of equipment.
 - .4 If the phase current for a piece of equipment is above rated nameplate current, prepare Equipment Line Phase Current Report that identifies cause of problem and corrective action taken.

3.11 TOUCH-UP PAINTING

- .1 Clean and touch up surfaces of shop painted equipment scratched or marred during shipment or installation, to match original paint.
- .2 Obtain necessary touch-up paint of original type and quality from equipment Manufacturer.
- .3 Clean surfaces to be painted. Feather out edges of scratch marks. Make patch inconspicuous.
- .4 Apply one or more coats until damaged surface has been restored to original finish condition.
- .5 Clean and prime exposed non galvanized hangers, racks and fastenings to prevent rusting.
- .6 Do not paint nameplates, tags, CSA labels, warning plates and operating instructions. Observe field painting of electrical equipment or raceways. Labels shall be visible and legible after the equipment is installed.

3.12 CLEANING

- .1 Clean construction debris and materials from enclosures, before final electrical tests. Vacuum the interior and exterior of enclosures to ensure all equipment is free from debris.

3.13 PROVISION FOR FUTURE EXPANSION

- .1 In each location where space for future equipment is indicated, leave such space clean. Install conduit, wiring and other work in such a manner that necessary connections can be made in future without dismantling existing equipment, raceways or wiring. Consult with Contract Administrator whenever necessary.

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3.14 TRAINING

- .1 Provide training of COW personnel in all aspects of maintenance, operation, and functionality for all systems.
- .2 Training shall be performed at the WEWPCC Facility in Winnipeg, Manitoba. Training shall involve both classroom style of training, as well as practical training with the equipment present.

3.15 UTILITY SERVICES

- .1 It is the responsibility of the Contractor to perform all work related to overhead services upgrades, and to coordinate this work with Manitoba Hydro. Coordinate all required power shutdowns with Manitoba Hydro.
- .2 Refer to other Contract Documents for additional scope of work and requirements..

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

- .1 26 05 00 – Common Work Results, Electrical.

1.2 REFERENCES

- .1 Canadian Standards Association (CSA International)
 - .1 CSA C68.10 - Shielded power cable for commercial and industrial applications, 5-46 kV

1.3 SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Provide product data in accordance with Section 01 33 00 - Submittal Procedures.
 - .1 Provide manufacturer's printed product literature, specifications, data sheet and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Quality assurance submittals: submit following in accordance with Section 01 45 00 - Quality Control.
 - .1 Manufacturer's Instructions: submit manufacturer's installation instructions and special handling criteria.
- .4 Perform and submit pull tension and side wall bearing pressure calculations signed and sealed by a Professional Engineer as part of the Shop-Drawing submittals.

1.4 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with manufacturer's written instructions.

Part 2 Products

2.1 GENERAL

- .1 Use armored type High Voltage (HV) TECK 90 cables for 25 kV cable applications.
- .2 All conductors (including grounds and bonds) shall be high conductivity copper.
- .3 Materials to be manufactured to Canadian CSA standards, approved and suitable for operation at minus 40 degrees C to plus 90 degrees C, and installation at temperatures down to minus 40 degrees C. Wires and cables shall meet the applicable CSA standard for construction and testing.
- .4 Insulation voltage rating: 12.6 kV cable shall be rated to a minimum of 25 kV.

- .5 Increase conductor sizes to account for loading, cable and conductor spacing with the associated de-rating factors, voltage drop, ambient temperature, equipment termination temperature ratings, and all other requirements in accordance with CEC requirements.
- .6 Cabling shall be compliant with the following flame test requirements:
 - .1 CSA FT-4
 - .2 IEEE 383 (70,000 BTU/hr)
 - .3 UL 1581 (70,000 BTU/hr)
 - .4 IEEE 1202 (70,000 BTU/hr) CSA FT-4
 - .5 ICEA T-30-520 (70,000 BTU/hr)
 - .6 ICEA T-29-520 (210,000 BTU/hr)
- .7 Other required compliances:
 - .1 EPA 40 CFR, part 261 for leachable lead content per TCLP
 - .2 OSHA acceptable
 - .3 RoHS Compliant
 - .4 Meets CSA cold bend test at -40 degrees C
 - .5 Meets CSA cold impact test at -40 degrees C

2.2 HV-TECK CABLE

- .1 Cables: to CSA- C68.10
- .2 Phase Conductors: Class B compact stranded high conductivity copper.
- .3 Conductor Extruded Strand Shield: Thermosetting semi-conducting polymeric strand shield extruded over the conductor.
- .4 Insulation Shield: A semi-conducting thermosetting layer, applied in a triple extrusion process plus a helically applied copper tape shield in contact with a bare stranded copper bonding conductor.
 - .1 Tape shield shall be a 3 mil annealed bare copper tape with a maximum 20 percent gap, and a minimum 10 percent overlap.
- .5 Bonding conductor: A bare stranded copper bonding conductor which shall be in direct contact with the copper insulation shielding tape.
- .6 Insulation: Tree-retardant cross-linked polyethylene (TR-XLPE).
 - .1 For 100 percent insulation level cables the insulation thickness shall be 175 mils (minimum), and
 - .2 For 133 percent insulation level cables insulation thickness shall be 220 mils (minimum).
 - .3 Cable insulation levels shall be as indicated on the Drawings, and Cable Schedules.
- .7 Inner jacket: Lead-free, flame retardant, moisture and sunlight resistant Polyvinyl Chloride (PVC), black in colour.

- .8 Armour: helically wound interlocked aluminum (steel armour is not accepted).
- .9 Outer jacket: Lead-free, Acid-flame-check flame retardant, moisture and sunlight resistant, FT4, "HL" rated polyvinyl chloride (PVC) material, suitable for direct burial, red in colour. The outer jacket shall be permanently marked (identified) in accordance with CSA C68.10, Section 12.
- .10 Acceptable cable Facility: General Cable, or approved equal in accordance with B8 - Substitutions.

2.3 HV-TECK CABLE CONNECTORS

- .1 Cable Connectors / Fittings:
- .2 Weatherproof strain relief style connectors, to accommodate cable shield, as recommended by the cable Facility.
- .3 Acceptable Cable Connectors: Thomas and Betts type Star TECK® sized for the applicable cable complete with locknut and grounding bushing, or approved equal in accordance with B8 - Substitutions.

2.4 HV-TECK CABLE TERMINATIONS

- .1 Shielded Cable Conductor Terminations: Heat shrink type cable terminations appropriately sized to the conductor and insulation dimensions.
 - .1 For inside or weather protected applications, terminators shall be without sheds.
 - .2 For outdoor non weather protected installations, terminators shall be equipped with sheds.
 - .3 All installations for multi-conductor cables shall include conductor "breakout boots" and "rejacketing tubing". Conductor breakout boots shall be utilized to seal the individual insulated phase conductors to the internal cable jacket to prevent water ingress to the cable.
- .2 Acceptable Cable Terminations: ABB ELASTIMOLD PCT21240-4 sized for the applicable cable, or approved equal in accordance with B8 – Substitutions.

2.5 PRIMARY OVERHEAD CONDUCTORS

- .1 Bare, A2 (AASC) high strength aluminum alloy, concentric-lay stranded conductors, size as indicated.

Part 3 Execution

3.1 INSTALLATION OF WIRES AND CABLES

- .1 Field Quality Control
 - .1 Perform tests in accordance with 26 08 05, Acceptance Testing.
- .2 General requirements

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- .1 Install wires and cables in a continuous length between termination points. Splices are not permitted, except where specifically approved by the Contract Administrator. Where splices are necessary and approved utilize the cable Facility approved and recommended kit.
 - .2 For outdoor or exposed installations, make all entries of cables or wires to equipment or panel from the bottom or side to minimize water entry points. Make no entries of cables or wires from the top unless specifically approved by the Contract Administrator.
 - .3 Do not embed cables or conduits in masonry or concrete without written approval from the Contract Administrator. Wiring through conduit sleeves for short, direct wall or floor penetration is accepted.
 - .4 Design wire and cable anchorage and support system for vertical and lateral loading in accordance with the Manitoba Building Code (MBC).
 - .5 Provide supports and accessories for installation of high voltage power cable.
 - .6 Install stress cones, terminations and splices in accordance with manufacturer's instructions
 - .7 Install grounding in accordance with local inspection authority having jurisdiction.
 - .8 Provide cable identification tags and identify each phase conductor of power cable.
- .3 Installation of armored cables:
- .1 Perform, and submit cable pulling and side wall bearing pressure calculations, sealed by a Professional Engineer as part of the Shop Drawing submittal.
 - .2 Utilize conductor pulling eyes for cable pulling. Cables shall NOT be pulled by utilizing only Kellems grips or other devices which attach only to the outer jacket or interlocked armour.
 - .3 Utilize a peak recording cable pulling dynamometer during cable pulling and record and provide a record maximum pulling tensions during pulling. Manufacturer's recommended cable pulling and sidewall bearing tensions shall not be exceeded during installation and pulling of cables.
 - .4 Provide a cable pull plan to the Contract Administrator prior to installing cables. In some cases, such as the cable pull to the BNR Facility, cable pull may have to be done at the pull pit midway in order to minimize cable pull tension.
 - .5 Install primary cables in trenches in accordance with Section 26 05 44 - Installation of Cables in Trenches and in Ducts.
- .4 Installation of bare overhead conductors:
- .1 Provide supports and accessories for installation of high voltage power cable.
 - .2 Provide connectors and accessories for installation of high voltage power cable.

3.2 COLOUR CODING AND TAGGING

- .1 Colour code all power distribution conductors at both ends throughout Facility.
- .2 Same colour for same phase throughout, by insulation colour markers.

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- .3 Conductor colour coding to be in accordance with CEC and as follows:
 - 3 Phase - red (A), black (B), blue (C)
- .4 Identify all cables with the cable tag at all termination points and at all pull boxes. All cable markers must be readily visible when the device cover is open.

3.3 FIELD QUALITY CONTROL

- .1 Perform tests in accordance with Section 26 05 00 - Common Work Results for Electrical.
- .2 Use of qualified tradespersons for installation, splicing, termination and testing of high voltage power cables.
- .3 Test high voltage power cable after it is routed. Submit test result and inspection certificate.

END OF SECTION

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Part 1 General

1.1 REFERENCE STANDARDS

- .1 CSA Group
 - .1 CSA C22.1, Canadian Electrical Code, Part 1, Safety Standard for Electrical Installations.
 - .2 CSA C22.2 No.41, Grounding and Bonding Equipment (Tri-National Standard, with NMX-J-590ANCE and UL 467).
 - .3 CSA C22.2 No.65, Wire connectors (Tri-National Standard, with UL 486A-486B NMX-J-543-ANCE).

1.2 SUBMITTALS

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

Part 2 Products

2.1 CONNECTORS AND TERMINATIONS

- .1 Splices:
 - .1 Utilize cable manufacturer approved splice kits.
 - .2 Acceptable Manufacturer: 3M or approved equal in accordance with B8.
- .2 Lugs and connectors:
 - .1 To CSA C22.2 No.65.
 - .2 Provide lugs / connectors for power and ground connections where required including:
 - .3 Where internal lugs are not included with a piece of equipment.
 - .4 Ground connections.
 - .5 Connectors shall be fabricated to include bushings or similar devices to prevent sharp edges from being in contact with conductor insulation.
 - .6 Lugs for power conductors shall be tin plated copper, long barrel compression type.
 - .7 Rated 25,000 volts of same material as conductor metal.
 - .8 Shall be suitable for 75 degrees C cable termination.
 - .9 Provide 1 hole compression lugs for conductors 1/0 AWG and smaller, 2 hole lugs for 2/0 AWG and larger conductors.
 - .10 Lugs for ground conductors 14 AWG and smaller, shall be ring type.
 - .11 Lugs for control wiring shall be spade or ring type.
 - .12 Hardware for bolting to cable lugs and ground lugs to ground bus shall be chrome plated Grade 5 bolts, nuts, split and flat washers.
 - .13 Lugs shall be compatible with the conductor size, the cable voltage rating, and the equipment connection.

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.14 Acceptable Manufacturer: Burndy, Thomas & Betts.

Part 3 EXECUTION

3.1 INSTALLATION

- .1 Install terminations, lugs, connectors, and splices in accordance with Manufacturer's instructions.
- .2 Wiring and connections should be made within junction boxes, termination cabinets, panels and devices. Use splice kits, only where absolutely necessary, and with specific approval from the Contract Administrator.
- .3 Splices shall only be used with specific written approval from the Contract Administrator. Otherwise, connection shall be made using suitable lugs and connectors in approved junction boxes or pull boxes.
- .4 Install connector bushings to prevent sharp edges from cutting or damaging conductor insulation.
- .5 Install stress cones, terminations, and splices in accordance with manufacturer's instructions.
- .6 Bond and ground as required to CSA C22.2No.41.

END OF SECTION

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Part 1 General

1.1 REFERENCE STANDARDS

- .1 CSA Group (CSA):
 - .1 CSA C22.1, Canadian Electrical Code latest edition, Part I, Safety Standard for Electrical Installations.
- .2 American National Standards Institute/Institute of Electrical and Electronics Engineers (ANSI/IEEE)
 - .1 ANSI/IEEE 837-02, Qualifying Permanent Connections Used in Substation Grounding.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Provide manufacturer's printed product literature, specifications and datasheet and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Quality assurance submittals: provide 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 and procedures.

1.3 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with manufacturer's written instructions.

Part 2 Products

2.1 MATERIALS

- .1 Rod electrodes: copper clad steel, 19 mm diameter by 3 m long.
- .2 For ground buses, electrode interconnections, metal structures, gradient control mats, transformers, switchgear, motors, or ground connections: Bare, stranded, tinned, soft-annealed copper wire, size No. 4/0 American wire gauge (AWG) and 2/0 AWG.
- .3 Conductors: bare, stranded tinned soft annealed copper wire, size No. 4 AWG for grounding cable sheaths, raceways, pipe work, screen guards, switchboards, potential transformers.
- .4 Conductors: pvc insulated coloured green, stranded tinned soft annealed copper wire No. 10 AWG for grounding metre and relay cases.

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- .5 Conductors: No. 4/0 AWG extra flexible (425 strands) copper conductor for connection of switch mechanism operating rod to gradient control mat, fence gates, vault doors.
- .6 Bolted removable test links.
- .7 Gradient control mat: copper, size 6 ft x 6 ft, 12 inches x 12 inches mesh and shall consist of copper 8 AWG minimum thick.
- .8 Accessories: non-corroding, necessary for complete grounding system, type, size material as indicated, including:
 - .1 Grounding and bonding bushings.
 - .2 Protective type clamps.
 - .3 Bolted type conductor connectors.
 - .4 Thermit welded type conductor connectors.
 - .5 Bonding jumpers, straps.
 - .6 Pressure wire connectors.
- .9 Wire connectors and terminations: as indicated.
- .10 Cable sheath isolating sleeves.

Part 3 Execution

3.1 INSTALLATION

- .1 Install continuous grounding system including, electrodes, conductors, connectors and accessories as indicated and to requirements of local authority having jurisdiction.
- .2 Ground fences to grounding system independent of station ground.
- .3 Install connectors and cadweld in accordance with manufacturer's instructions.
- .4 Protect exposed grounding conductors during and after construction.
- .5 Make buried connections, and connections to electrodes, structural steel work, using copper welding by thermit process.
- .6 Use mechanical connectors for grounding connections to equipment provided with lugs.
- .7 Use No. 4/0 AWG bare copper cable for main ground bus of substation and No. 2/0 AWG MHD bare copper cable for taps on risers from main ground bus to equipment.
- .8 Use tinned copper conductors for aluminum structures.
- .9 Do not use bare copper conductors near un-jacketed lead sheath cables.

3.2 ELECTRODE INSTALLATION

- .1 Install ground rod electrodes. Make grounding connections to station equipment.
- .2 Install ground rod electrodes at transformer and switchgear locations.
- .3 Install gradient control mats. Connect mats to station ground electrode and switch mechanism operating rods.

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- .4 Make special provision for installing electrodes that will give acceptable resistance to ground value, where rock or sand terrain prevails.

3.3 EQUIPMENT GROUNDING

- .1 Install grounding connections as indicated to typical station equipment including: line sky wire, neutral, gradient control mats. Non-current carrying parts of: transformers, generators, motors, circuit breakers, reclosers, current transformers, frames of gang-operated switches and fuse cutout bases. Cable sheaths, raceways, pipe work, screen guards, switchboards, potential transformers. Meter and relay cases. Any exposed building metal, within or forming part of station enclosure. Sub-station fences, pothead bodies. Outdoor lighting.
- .2 Ground hinged doors to main frame of electrical equipment enclosure with flexible jumper.

3.4 POLE MOUNTED SWITCHING DEVICE GROUNDING

- .1 Install gradient control mat at base of each pole on which group-operated line switching devices are mounted, located mat so that operator must stand within gradient control mat footprint to operate switch.
- .2 Connect gradient control mat to base of switch operating handle with two (2) No. 4/0 AWG extra flexible copper conductor, and join to switch operating handle ground wires.
- .3 Connect operating handle of switch to handle base with No. 4/0 AWG extra flexible copper conductor.

3.5 CABLE SHEATH GROUNDING

- .1 Bond single conductor, metallic sheathed cables together at one end only. Break sheath continuity by inserting insulating sleeves in cables.
- .2 Use No. 6 AWG flexible copper wire soldered, not clamped, to cable sheath.
- .3 Connect bonded cables to ground with No. 2/0 AWG copper conductor.

3.6 FIELD QUALITY CONTROL

- .1 Perform tests in accordance with Section 26 05 00 - Common Work Results for Electrical.
- .2 Engage an independent testing agent to inspect grounding and perform ground resistance test before backfill.
- .3 Perform earth loop test and resistance tests using method appropriate to site conditions and to approval of Consultant and local authority having jurisdiction.
- .4 Perform test before energizing electrical system.
- .5 Provide step-and-touch potential calculations using measured station ground resistance measurements. Submit test result and inspection certificate before energizing electrical system.

END OF SECTION

Part 1 General

1.1 NONE

- .1 None.

Part 2 Products

2.1 FRAMING AND SUPPORT SYSTEM

- .1 Materials:
 - .1 Conduit support structures shall employ an aluminum strut framing system together with the manufacturer's connecting components and fasteners for a complete system.
- .2 Finishes:
 - .1 Wet locations: Aluminum.
 - .2 Indoors, dry locations: Aluminum.
 - .3 Nuts, bolts, machine screws: Stainless steel.
- .2.2 **CONCRETE AND MASONRY ANCHORS**
 - .1 Materials: hardened steel inserts, zinc plated for corrosion resistance.
 - .2 Components: non-drilling anchors for use in predrilled holes, sized to safely support the applied load with a minimum safety factor of four (4).
 - .3 Manufacturer: Hilti (Canada) Limited or approved equal in accordance with B7.

Part 3 Execution

3.1 INSTALLATION

- .1 Secure equipment to solid masonry, tile and plaster surfaces with galvanized anchors.
- .2 Secure equipment to poured concrete with expandable inserts.
- .3 Secure equipment to hollow masonry walls or suspended ceilings with toggle bolts.
- .4 Support equipment, conduit or cables using clips, spring loaded bolts, cable clamps designed as accessories to basic channel members.
- .5 Maximum spacing between conduit supports as per CEC requirements.
- .6 Fasten exposed conduit or cables to building construction or support system using straps.
 - .1 One (1) hole aluminum straps to secure surface conduits and cables 50 mm in diameter and smaller.

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- .2 Two (2) hole aluminum straps for conduits and cables larger than 50 mm in diameter.
- .7 Suspended support systems.
 - .1 Support individual cable or conduit runs with 6 mm dia threaded rods and spring clips.
 - .2 Support two (2) or more cables or conduits on channels supported by 6 mm diameter threaded rod hangers where direct fastening to building construction is impractical.
- .8 For surface mounting of two (2) or more conduits use channels, with maximum centre spacing as indicated above.
- .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 where there is no wall support.
- .11 Do not use wire lashing or perforated strap to support or secure 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 the Contract Administrator.
- .13 Install fastenings and supports as required for each type of equipment cables and conduits, and in accordance with manufacturer's installation recommendations.
- .14 Touch up abraded surfaces and cut ends of galvanized members with an approved galvanizing repair compound.

END OF SECTION

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Part 1 GENERAL

1.1 CODES AND STANDARDS

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

1.2 SUBMITTALS

- .1 Submit product data in accordance with Section 01 33 00, Submittal Procedures.
- .2 Submittals shall include, but not be limited to the following:
 - .1 Precast manholes and handholes.
 - .2 Dimension drawings and descriptive literature.
 - .3 Cable pulling calculations for all cables.
 - .4 Proposed cable pulling methodology to ensure pulling forces are within the cable Manufacturer's limits.

Part 2 PRODUCTS

2.1 MARKERS AND PROTECTION

- .1 Wooden protection:
 - .1 38 mm by 140 mm planks pressure treated with copper naphthenate or 5 percent pentachlorophenol preservative. Creosote and some other types of wood preservatives may injure the insulation of conductors and should not be used.
- .2 Concrete topping protection:
 - .1 Concrete topping of conduit in trench, minimum 50mm thick layer of concrete, dyed red, with a 150mm overhang, past the edges of each conduit installed for the length of the trench.
- .3 Markers:
 - .1 Concrete type cable markers: 600mm by 600mm by 100mm with words: cable, joint or conduit impressed in top surface, with arrows to indicate change in direction of cable and duct runs.
 - .2 Cedar post type markers: 89mm by 89 mm, 1.5 m long, treated with copper naphthenate or 5 percent pentachlorophenol preservative, with nameplate fastened near post top, on side facing cable or conduit to indicate depth and direction of duct and cable runs.
 - .3 Nameplate: aluminum, anodized 89mm by 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. Fasten using stainless steel screws.

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- .4 Warning tape:
 - .1 Material: Polyethylene, 4-mil gauge with detectable strip.
 - .2 Color: Red.
 - .3 Width: Minimum 150 mm.
 - .4 Designation: Warning on tape that electric circuit is located below tape.
 - .5 Identifying Letters: Minimum 25 mm high permanent black lettering imprinted continuously over entire length.
 - .6 Manufacturers and Products:
 - .1 Panduit; Type HTDU.
 - .2 Reef Industries; Terra Tape.
 - .3 W.H. Brady Inc.
 - .4 Wieland Electric Inc.

Part 3 EXECUTION

3.1 GENERAL

- .1 Provide Universal GPS coordinates of all underground cable or conduit runs at every bend, and at a maximum of 6000mm intervals. Include coordinates on the As-Built drawings.
- .2 All cable / conduit trenches shall have a red plastic warning tape placed above, buried at a depth of 305mm below grade. The plastic tape is to completely cover all conduits, and overlap the width of all conduits by at least 150mm on either side. Use multiple parallel tape runs as required.
- .3 Maintain a minimum of 1200mm horizontal clearance distance from underground structures such as buildings and equipment foundations.
- .4 Maintain a minimum of 600mm horizontal clearance distance from other underground equipment or services.
- .5 Clearances to be in strict accordance with the Winnipeg Electrical Bylaws (WEB), CEC, and all other applicable bylaws.
- .6 For underground conduits or cables, provide mechanical protection as follows:
 - .1 120 V or 600V and 15A to 90A: mechanical protection using treated planks
 - .2 600V and below; and 100A or greater: mechanical protection using 50 mm thick concrete topping, or concrete duct banks as directed on the Drawings.
 - .3 600V to 25 kV: mechanical protection using 50 mm thick concrete topping, or concrete duct banks as directed on the Drawings
- .7 Backfill:

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- .1 Use clean backfill, free of rocks and debris. Return excavation area to the original condition.
- .2 Photograph all open trenches, with cabling, conduit, supports and spacers installed.
- .3 Do not backfill until inspected by Contract Administrator.
- .8 Prior to excavation or directional boring, perform a complete site survey to ensure that the installation will not conflict with existing systems. Repair of damages to existing systems will be at the cost of the Contractor.
- .9 Coordinate work with other trades to ensure that the location and route of the buried systems does not conflict with the work of other trades.
- .10 Refer to the Drawings for cable / trench details where applicable. Where conflict in details occurs, allow for the more onerous and costly installation method.
- .11 Provide a 4/0 copper bonding cable throughout the entire concrete duct bank system (run inside one of the system ducts). Make connections to all manholes with the bonding conductor. Ground the system bonding conductor to the ground grid at the Facility.
- .12 Employ soft dig excavation methods near and around any buried electrical system. An acceptable soft dig method is Hydrovac (water based) excavation method.

3.2 DIRECTIONAL BORING

- .1 Perform directional boring as directed on the Drawings, or as specifically approved by the Contract Administrator. Otherwise, use open trenching installation methods.
- .2 Directional boring shall utilize HDPE conduit.

3.3 DIRECT BURIAL OF CABLES

- .1 Perform excavation, and trenching. Provide sand bed in trench, and lay in cables, maintaining separation between cable runs. Maintain a minimum of 75 mm of clearance from each side of trench to the nearest cable. Do not pull cable into trench.
- .2 Provide offset for thermal action and minor earth movements. Offset 150 mm for each 60m run, maintaining minimum cable separation and bending radius requirements.
- .3 Make terminations and splices (splices - only where specifically approved by the Contract Administrator) leaving 0.6 m of surplus cable in each direction.
 - 1. Terminations and splices shall be performed with approved kits, and in accordance with the Manufacturer's instructions and with specific training.
- .4 Underground cable splices are not acceptable.

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- .5 Minimum permitted radius at cable bends for rubber or plastic cables, 8 times diameter of cable; for metallic armoured cables, 12 times diameter of cables or greater in accordance with the Manufacturer's instructions.
- .6 Cable separation:
 - .1 Maintain 300 mm minimum separation between low voltage cables of different circuits.
 - .2 Maintain 300 mm minimum horizontal separation between low and medium voltage cables.
 - .3 Maintain 300 mm minimum vertical separation where low voltage and medium voltage cables cross, with the low voltage cables in the upper position.
 - .4 Maintain 300 mm minimum horizontal, and 300 mm minimum vertical separation between fire alarm and control cables when crossing other cables, with the fire alarm and control cables in the upper position.
 - .5 Install treated planks at cable crossings, between lower and upper cables, extending 600 mm in each crossing direction.
 - .6 The Contractor must meet the minimum code clearance requirements when crossing of any other systems, such as mechanical or utility services.
- .7 Provide sand bed over cables, after the cables are laid into the trench. Minimum sand bedding below cables is 75 mm. Minimum sand bedding above cables is 75 mm. Supply and install mechanical protection of cables above sand bedding. Use clean fill, devoid of rocks or materials which can damage or deform the cable trench.
- .8 Repair surface to previous existing condition, or to new conditions specified on the Drawings, and in the Specifications.
- .9 Prior to closing up trench, and covering cables, photograph the open trench with the cables installed, and arrange for an inspection by the Contractor Administrator. Do not close up trench without approval.
- .10 Minimum cable burial depth shall be in accordance with the CEC, table 53, or deeper as specified on the Drawings.

3.4 CABLE INSTALLATION IN DUCTS

- .1 Inspect and clean ducts prior to installing cables.
- .2 Install cables as indicated in ducts.
 - .1 Do not pull spliced cables inside ducts.
- .3 Use CSA approved lubricants of type compatible with cable jacket to reduce pulling tension.

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- .4 Before pulling cable into ducts and until cables are properly terminated, seal ends of cables with moisture seal tape.
- .5 After installation of cables, seal duct ends with duct sealing compound.
- .6 Avoid moisture traps where possible. When unavoidable in exposed conduit runs, provide junction box and drain fitting at conduit low point.
- .7 Group raceways installed in same area.
- .8 Install watertight fittings in outdoor, underground, or wet locations.
- .9 Utilize conductors that are rated for underground direct earth burial in underground ducts.
- .10 Provide expansion fittings that allow minimum of 100 mm of movement in vertical conduit runs from underground where exposed conduit will be fastened to or will enter building or structure.
- .11 Provide slack loops in cable, compatible expansion fittings.

3.5 MARKERS

- .1 Provide cedar post type or concrete pad style markers for buried cable or conduit runs above 600V and for all concrete encased duct banks.

END OF SECTION

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Part 1 General

1.1 REFERENCES

- .1 NETA Acceptance Testing Specifications, 2003 (ATS-2003)

1.2 TESTING REPORT

- .1 Prepare an overall inspection and test report that details all investigations and tests.
- .2 The Contractor shall furnish paper copies in the hard-copy O&M Manuals and electronic copies O&M Manual.
 - .1 The electronic copies of the report, including the test forms, shall be provided in PDF format.
 - .2 The Microsoft Word version of the all completed test forms provided to the Contractor shall also be included in the electronic copy.
- .3 The report shall be neat and organized. Any omissions, inconsistencies, or incomplete work identified by the Contract Administrator shall be corrected and incorporated into the report in the appropriate section, and completely resubmitted.
- .4 A draft of each report shall be completed and sent to the Contract Administrator for review a maximum of one month after the completion of the inspections at the Site.
- .5 The final report shall be submitted a maximum of two weeks after the Contractor receives the mark-up of the draft report from the Contract Administrator.
- .6 The report shall include the following:
 - .1 Summary of project.
 - .2 Testing Equipment.
 - .3 Detail the type, manufacturer, model, and last calibration date of all testing equipment.
 - .4 Description of equipment tested.
 - .5 Description of all tests.
 - .6 Typed inspection forms including:
 - .1 Identification of the testing organization.
 - .2 Equipment identification.
 - .3 Humidity, temperature, and other conditions that may affect the results of the tests/calibrations.
 - .4 Date of inspections, tests, maintenance, and/or calibrations.
 - .5 Identification of the testing technician.
 - .6 Indication of inspections, tests, maintenance, and/or calibrations performed and recorded, along with charts, and graphs as applicable. All measurements and readings taken shall be noted for inclusion in the report. Where repairs are made, measurements and readings before and after the repair shall be included.

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- .7 Indication of expected results, when calibrations are to be performed.
- .8 Indication of “as-found” and “as-left” results, as applicable.
- .7 Itemized list of all repaired deficiencies which shall include:
 - .1 Detailed description of the deficiency.
 - .2 The cost associated with the deficiency repair.
- .8 Itemized list of all un-repaired deficiencies encountered which shall include:
 - .1 Detailed description of the deficiency.

Part 2 Products

2.1 NOT USED

- .1 Not Used

Part 3 Execution

3.1 SCOPE OF TESTING

- .1 All medium voltage cables,
- .2 All low voltage cables 1/0 AWG or larger,
- .3 Grounding system,
- .4 25kV Gang Operated Switch,
- .5 25kV Fuse Holders,
- .6 Check phase rotation to ensure that all existing motors within the facility will be rotating correctly prior to putting the systems into service.
- .7 Check, confirm and document cable termination torque settings.

3.2 INSPECTION, TESTING AND MAINTENANCE PROCEDURES

- .1 General
 - .1 All tests are based on NETA (InterNational Electrical Testing Association) standard ATS-2003. Where manufacturer’s specifications, tolerances, and/or published data are not available, refer to the appropriate tables in ATS-2003.
 - .2 Torque all accessible bolted electrical connections. Additional requirements apply as specified.
 - .3 Utilize the existing drawings for reference while performing the specified electrical inspection work. Where the existing installation deviates from that shown on the drawings, mark-up the drawings with red pen as required to reflect the installation. Include the marked-up drawings in the report.
 - .4 The scope of required drawing checks is limited to the equipment and components that are part of the electrical inspection work.

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- .5 Any repairs made that affect the accuracy of the drawings shall be marked up on the drawings.
 - .6 Drafting of drawings is not required.
 - .7 All inspection values, readings, corrections, and assessments shall be clearly recorded for inclusion within the report.
 - .8 Where corrections or repairs are made, record both as found/as left test readings on the inspection sheet. If space is not provided on the inspection form, record the readings in the Note fields or on a separate sheet.
- .2 Inspection Forms
- .1 The inspection forms to be completed by the Contractor are provided for reference in PDF format.
 - .2 Microsoft Word form templates will be provided prior to the work being initiated.
 - .3 Make appropriate print-outs of the inspection forms and utilize for entry of data and test results on site.
 - .4 Utilizing the Microsoft Word form templates, enter the data recorded manually into the forms electronically.
 - .5 Complete the inspection forms in the entirety and include them in the report.
 - .6 Submit electronic PDF copies of the inspection forms.
 - .7 The scope of work required in the specifications is in no way limited by the inspection forms, or spaces provided. Provide additional pages, documents, and forms as required to provide a complete report.
 - .8 The inspection forms may be updated during the Work by the City or Contract Administrator. Utilize the latest forms provided.

3.3 WIRES AND CABLES, GREATER THAN 1000 V

- .1 Inspection and testing shall consist of the following:
 - .1 For cables/wires 1/0 AWG or larger, inspect bolted electrical connections for high resistance using a low-resistance ohmmeter. Compare bolted connection resistance values to values of similar connections. Investigate and correct values which deviate from those of similar bolted connections by more than 50 percent of the lowest value.
 - .2 Torque all accessible bolted electrical connections.
 - .3 Inspect compression applied connectors for correct cable match and indentation.
 - .4 Inspect grounding and cable/conduit support.
 - .5 Verify that visible cable bends meet or exceed the minimum allowable bending radius.
 - .6 Measure length of cable/conduit and record in meters.
 - .7 If cables/wires are terminated through window-type current transformers, inspect to verify that neutral and ground conductors are correctly placed and that shields are correctly terminated for operation of protective devices.
 - .8 Perform an insulation-resistance test on each conductor. Individually test each conductor with all other conductors and shields grounded. The test duration shall be one minute. Investigate resistances less than 1000 megaohms. The voltage

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applied shall be 500 Vdc for 300 V rated cables, and 1000 Vdc for 600 V or 1000 V rated cables.

3.4 GROUNDING SYSTEM

- .1 Inspection and testing shall consist of the following:
 - .1 Perform resistance tests between the main grounding electrode and grounded points in the electrical distribution system. Investigate connections with a resistance greater than 0.5 milliohms.

END OF SECTION

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Part 1 GENERAL

1.1 REFERENCE STANDARDS

- .1 CAN/CSA C2.1:24, Single-Phase and Three-Phase Liquid-Filled Distribution Transformers.
- .2 CSA C227.4:21, Three-phase, pad-mounted distribution transformers with separable insulated high-voltage connectors
- .3 ANSI/IEEE 386, IEEE Standard for Separable Insulated Connector Systems for Power Distribution Systems Rated 2.5 kV through 35 kV

1.2 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's printed product literature, specifications and datasheet and include product characteristics, performance criteria, and limitations.
- .3 Submit shop drawings and indicate:
 - .1 Dimensioned positions of mounting devices.
 - .2 Dimensioned positions of terminations.
 - .3 Identified internal and external component layout on assembly drawing.
 - .4 Insulating liquid capacity.
- .4 Quality Assurance Submittals: submit following in accordance with Section 01 45 00 - Quality Control.
 - .1 Certificates: submit production certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
 - .2 Instructions: Submit manufacturer's installation instructions.
 - .1 Provide 2 copies of systems supplier's installation instructions.
- .5 Closeout Submittals:
 - .1 Provide maintenance data for liquid-filled transformers for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.
 - .2 Include insulating liquid maintenance data.

1.3 DELIVERY, STORAGE, AND HANDLING

- .1 Ship transformer complete with first fill of liquid.
- .2 Ship transformer pressurized with inert gas at positive pressure as per manufacturer's recommendation.
- .3 Transformers shall be loaded and unloaded with overhead cranes.

1.4 MAINTENANCE

- .1 Supply maintenance materials in accordance with Section 01 78 00 - Closeout Submittals.

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1.5 GENERAL

- .1 It is the responsibility of the electrical contractor to review the installation and characteristics of the existing 2500kVA transformers at WEWPCC and ensure the existing installation can be modified as required to accommodate removal of existing transformer and installation of new transformer with the re-utilization of existing line, load side feeders, and external power and control wiring. Coordinate the size/compartment/ locations on the approved Shop Drawings prior to installing transformer.

Part 2 PRODUCTS

2.1 APPROVED MANUFACTURERS

- .1 Approved Equipment Manufacturer: Carte, Delta Star, PTI, ABB, Cooper Power Systems or approved equal in accordance to B8.

2.2 TRANSFORMER CHARACTERISTICS

- .1 Transformers: To CAN/CSA C2.1:24
- .2 Type: Substation style transformer.
- .3 Liquid cooled, outdoor, distribution transformer type KNAN/KNAF with fan cooling.
- .4 Primary Voltage: 12.47 kV, 60 Hz, delta connected, 3 phase, 3 wire.
- .5 Secondary Voltage: 600 V, wye connected, 3 phase, 4 wire, grounded neutral suitable for delta-wye connection.
- .6 Capacity: 2500kVA
- .7 Additional rating (KNAN/KNAF rated cooling): 3300kVA
- .8 Windings: Copper.
- .9 Core: Cold rolled grain oriented steel lamination.
- .10 Primary basic impulse level: 95 kV/ Secondary basis impulse level: 30 kV
- .11 Impedance: 6.75% minimum
- .12 Temperature rise: 65 degrees C.
- .13 Liquid: Ester Dielectric (Envirotemp FR3), PCB free, suitable for arctic conditions.
- .14 Sound rating: As per CSA C227.4 Table 5.
 - .1 2500 kVA: 62 dBA
- .15 CSA Certified.
- .16 Primary fuse protection – Bay-O-Net and current limiting fuses.
- .17 Transformer shall withstand thermally and mechanically a two second short circuit at its secondary terminals.
- .18 The transformer shall be cooled by the natural circulation of air over the tank surface, with an additional rating obtained by forced air circulated over the radiators or corrugate. The unit shall be provided with KNAN/KNAF rated cooling including fans and control equipment. Control power shall be provided by others. Additional capacity ratings shall be 33% for 2,500 kVA.

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- .19 Primary and secondary feeds will be fed from opposite end of the transformer with the primary on the left end and secondary on the right (front of transformer facing south at the plant). Both the primary and secondary cables are underground fed.

2.3 CONSTRUCTION

- .1 Panel type radiators or corrugate type cooling are welded directly to the tank when additional cooling is required.
- .2 The tank must be welded using precision cut, cold-rolled steel plate and equipped with extra-heavy duty, welded-in-place lifting lugs and jacking provisions. The tank base must be designed to allow skidding and rolling. Base of transformers shall be suitable for floor mounting in concrete pad in outdoor substation.
- .3 The tank shall include a pressure relief device as a means to relieve pressure in excess of pressure resulting from normal operation.
- .4 The high and low voltage terminations shall each be located enclosed in a full height, bottom entry cabinet with window for infrared thermography.
 - .1 A full height bottom entry air terminal chamber is a weather-resistant metal enclosure around sidewall mounted bushings that extends downward to the transformer base level and upward approximately 10 inches above the bushing centerline. It is intended for underground feed and is provided with facilities for distribution arresters, a hinged door with padlockable handle and a hexhead bolt.
- .5 Transformer shall be suitable for termination of conductors as indicated on the Drawings.
- .6 High voltage bushings and terminals
 - .1 The transformer shall be provided with three (3) sidewall-mounted high voltage bushings plus an Ho neutral bushing for WYE connected transformers rated for full three-phase duty with a 2-hole spade. The high voltage bushings shall be mounted in segment 2 of the transformer.
- .7 Low voltage bushings and terminals
 - .1 The low voltage bushings shall be sidewall-mounted. For voltages less than 1000V bushings shall be molded epoxy with a 12 -Hole NEMA spade, suitable for a minimum of 6 cables per phase, 6 cables per neutral.
 - .2 The low voltage bushings shall be located in the segment opposite of the specified high-voltage configuration.
 - .3 Terminals shall be tinned copper bus bar.
- .8 Insulated neutral X0 bushing with a removable ground strap accessible from the cable compartment to incorporate NGR installation where required. Xo should not be connected to ground that is internal to the oil-filled transformer compartment.
- .9 Copper grounding bus. Provisions for a minimum of 8 ground cables.
- .10 Kirk Key Interlock between transformer door and upstream pole mounted gang operated switch. Key is to be released via the upstream pDole mounted gang operated switch mechanism.
- .11 Vibration dampers: Anti-vibration mountings to isolate not less than 90% of disturbing vibrations.

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2.4 ACCESSORIES

- .1 The following accessories shall be provided:
 - .1 De-energized tap-changer on primary winding, externally operated with provision for padlocking. The tap changer shall be functional to -40°C ambient temperature operation and have at minimum two taps above and two taps below at 2.5% increments. All taps shall be full capacity.
 - .2 1.0" upper fill plug with filter press connection
 - .3 1.0" drain valve with sampling device
 - .4 Cover-mounted automatic pressure relief device
 - .5 Welded cover with bolted manhole
 - .6 Lifting lugs (4)
 - .7 Liquid level monitoring gauge with alarm and trip contacts
 - .8 Winding temperature indicator with alarm and trip contacts. Temperature probe shall be located in the center of winding.
 - .9 Pressure/vacuum gauge with alarm and trip contacts
 - .10 SS ground pads (4)
 - .11 Touch-up paint (2 aerosol cans)
 - .12 NEMA 4X control box
 - .13 Rapid pressure rise relay
 - .14 Seal-in panel for rapid pressure rise relay
 - .15 Wiring and terminal box for protective devices.
 - .16 Forced air fan control package
 - .17 Oil fill, drain and sample valves.
 - .18 Primary side surge arrestors.

2.5 FINISH

- .1 The tank coating shall meet all requirements in IEEE Std C57.12.28™-2014 standard including:
 - .2 Salt Spray
 - .3 Crosshatch adhesion
 - .4 Humidity
 - .5 Impact
 - .6 Oil resistance
 - .7 Ultraviolet accelerated weathering
 - .8 Abrasion resistance
 - .9 Exterior Finish: Munsell 7GY3.29/1.5 Green.

2.6 EQUIPMENT IDENTIFICATION

- .1 Provide equipment with a stainless steel laser engraved combined nameplate and connection diagram.
- .2 The combined nameplate and connection diagram shall be located on the low-voltage side or in the vicinity of the accessories.

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- .3 The following information shall be shown on the nameplate:
- .1 type (ONAN, LNaN, or KNaN) 60 Hz, 65 °C;
 - .2 number of phases;
 - .3 rating in kilovolt amperes (kVA);
 - .4 identification number (e.g., serial number);
 - .5 percent impedance at 85 °C (one decimal minimum);
 - .6 liquid insulant type and volume in litres;
 - .7 Basic impulse level (BIL);
 - .8 Total mass (including liquid) in kilograms;
 - .9 Rated high and low voltages;
 - .10 <2 ppm PCB;
 - .11 Tap voltages in percent of rated voltage and corresponding position of tap switch;
 - .12 Terminal markings, including physical identification and diagram of connections, and vector diagram for three-phase transformers;
 - .13 Year and month of manufacturer;
 - .14 CSA Standard number;
 - .15 Manufacturer reference number;
 - .16 Name of manufacturer and address location of manufacturing plant;
 - .17 Energy efficiency in accordance with CSA C802.1; and
 - .18 Bayonet fuse and current limiting fuse identification (if applicable).
- .4 Provide size 11, hard plastic equipment identification lamaroid on the outside of the transformer, example as follows:

2,500/3,300 kVA, 12.47 kV-600 V, 3Ø, 4W

2.7 SOURCE QUALITY CONTROL

1. Submit to the Departmental Representative standard factory test certificates of each transformer and type test of each transformer with high voltage accessories in accordance with CSA C2 and Specification Section 26 08 05, Acceptable Testing. Include test results in the O & M Manuals.

Part 3 EXECUTION

3.1 MANUFACTURER'S INSTRUCTION

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

3.2 INSPECTION

1. Check factory made connections of transformer unit for mechanical tightness and electrical continuity.
1. Check transformer insulating liquid for correct quantity and Specification according to Manufacturer's instructions.

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2. Confirm that the neutral Xo terminal is insulated and not internally grounded.
3. All other requirements per Section 26 08 05, Acceptance Testing.

3.3 PRODUCTION TESTING

- .1 Transformer shall undergo all applicable tests as required by applicable standards, such as but not limited to:
 - .1 Standard Routine Tests
 - .1 All units shall be tested for the following:
 - .1 Ratio, polarity and phase relation tests using all tap settings
 - .2 Winding resistance measurement tests
 - .3 Insulation power factor
 - .4 Full wave and reduced wave impulse test
 - .5 Applied and induced potential tests
 - .6 No-Load losses at 100% rated voltage
 - .7 No-Load losses at rated current
 - .8 Total losses at rated current
 - .9 Percent impedance at rated current
 - .10 Excitation current (100% voltage) test
 - .11 Leak test
 - .12 Impulse test performed in accordance with IEEE C57.12.90-2021, Clause 10.4
 - .2 All test reports submitted to the purchaser for each manufacturing lot shall contain the following:
 - .3 Confirmation that the report is certified by the manufacturer;
 - .1 Acknowledgement that all routine tests have been performed;
 - .2 Documentation confirming the energy efficiency according to CSA C802.1;
 - .3 Confirmation of the values of the tests specified in Clause 3.03.0.1
 - .4 The signature of a professional engineer or otherwise authorized person.
 - .2 Tolerance for routine test
 - .1 Ratio: all voltages shall be correct within 0.50% of the nameplate markings. Rated tap voltage shall correspond to the voltage of the nearest turn if the voltage per turn exceeds 0.50% of the nameplate markings.
 - .2 Individual transformers: losses for individual transformers on a given order shall not exceed the guaranteed values by more than 10% for no-load losses and exciting current, or by more than 6% for total losses.
 - .3 Tolerances for impedance
 - .1 Guarantee
 - .1 The impedance of a transformer shall not vary from the guaranteed value by more than $\pm 7.5\%$ for transformers with a guaranteed value of 2.5% or higher, and $\pm 15.0\%$ for transformers with a guaranteed value below 2.5%.

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- .2 Nameplate
 - .1 The impedance value of the transformer as it appears on its nameplate shall be the tested value rounded to one decimal place, corrected to 85 °C.
- .2 Standard Type Tests
 - .1 In addition to standard route test, the following tests shall be performed as standard type tests:
 - .1 resistance;
 - .2 temperature rise;
 - .3 impulse strength;
 - .4 mounting bracket loading for pole-mounted transformers;
 - .5 radio influence voltage;
 - .6 short-circuit;
 - .7 transformer enclosure fault current capability for cylindrical transformer enclosures; and
 - .8 Core audible sound level.
 - .2 The manufacturer shall provide a record of type tests to the purchaser at the time of order. The test data may be provided from tests performed on other units whose equivalence, with regard to each required test, is acceptable to the purchaser.
- .3 Dielectric tests
 - 1. Applied voltage test
 - 2. Three-phase transformer, permanently grounded
 - 3. Impulse strength tests
- .4 Temperature rise test
- .5 Short-circuit tests
- .6 Transformer enclosure fault current capability test
- .7 For all additional tests, the manufacturer shall provide a record of tests to the purchaser at the time of order, upon request. The test data may be provided from tests performed on other units whose equivalence, with regard to each required test, is acceptable to the purchaser.
- .8 All factory tests shall be documented, dated and signed by the testing technician(s) with electronic copies submitted to Contract Administrator for approval prior to shipments from the factory. Include test results in the Operation & Maintenance Manual.
- .9 Any failure to meet the requirements of the Specifications shall be corrected promptly by the Contractor after which the transformer shall be retested. If, after correction and retesting, the transformer still fails to meet the requirements of the Specifications, it may be rejected.
- .10 Do not ship transformer to site until:
 - .1 Factory tests for are completed.
 - .2 Factory test reports have been submitted to Contract Administrator.
 - .3 Compliance with performance requirements has been demonstrated.
 - .4 Contract Administrator has given approval for shipping to proceed.

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3.4 INSTALLATION

- .1 Transformer will act a spare supply transformer for the station. Transformer shall be shipped to site and contractor shall provide the necessary equipment to move transformer to the final storage location. All on site testing to be complete prior to storage.

3.5 SITE QUALITY CONTROL

- .1 Carry out following insulation tests using megger with 20,000 megohm scale and resulting insulation resistance corrected to base of 20 degrees C.
 - .1 High voltage to ground with secondary grounded for duration of test.
 - .2 Low voltage to ground with primary grounded for duration of test.
 - .3 High to low voltage.
- .2 Inspect and clean bushings and insulators.
- .3 Check oil level and temperature indicators.
- .4 Set transformer taps to rated voltage as specified.
- .5 Inspect for oil leaks and excessive rusting.
- .6 Inspect oil level.
- .7 Check fuses for correctness of type and size.
- .8 Check for grounding and neutral continuity between primary and secondary circuits of transformer.

END OF SECTION

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Part 1 General

1.1 REFERENCE STANDARDS

- .1 American National Standards Institute (ANSI)/Institute of Electrical and Electronics Engineers (IEEE)
 - .1 ANSI/IEEE C37.46, Specifications for High Voltage Explosion and Current-Limiting Type Power Class Fuses and Fuse Disconnecting Switches.
- .2 Electrical and Electronic Manufacturers Association of Canada (EEMAC)
 - .1 EEMAC G1-1, Indoor and Outdoor Switch and Bus Insulators.
- .3 National Electrical Manufacturers Association (NEMA)
 - .1 NEMA SG2, High-Voltage Fuses.

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 outdoor load break switches and fuses and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Shop Drawings:
 - .1 Submit drawings stamped and signed by professional engineer registered or licensed in Province, Canada.
 - .1 Indicate on drawings:
 - .1 Load break mechanism.
 - .2 Switching type.
 - .3 Mounting design.
 - .4 Fuse holder mechanism.
 - .5 Gang operating mechanism.
 - .6 Load rating.

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 outdoor load break switches and fuses for incorporation into manual.

1.4 MAINTENANCE MATERIAL SUBMITTALS

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

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1.5 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store materials indoors in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect outdoor load break switches and fuses from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.

Part 2 Products

2.1 MATERIALS

- .1 Fuses: to NEMA SG2 and ANSI C37.46.
- .2 Insulators: to EEMAC G1-1 and NEMA.

2.2 FULL LOAD AIR BREAK SWITCHES

- .1 Vertical mounted, vertical break, gang operated, single throw, 3 pole.
- .2 Rating 900 A, 25 kV.
 - .1 Momentary RMS asymmetrical A: 65,000.
- .3 Insulators: three per pole, standard station post type.
- .4 Contacts:
 - .1 Silver-plated multi-contact fixed contacts.
- .5 Interrupter unit to permit opening and closing under rated full load currents consists of:
 - .1 Mechanism actuated by levers for operating contacts.
 - .2 Bolted to fixed contact assembly of switch.
 - .3 Shunt contact bolted to switch blade actuates interrupter unit when blade is moved to open or closed position.
- .6 Switch base: 5 mm formed channel galvanized steel drilled for universal mounting on wood.
- .7 Interphase mechanism assembly.
 - .1 Operated from centre pole.
 - .2 Poles interconnected by articulated pipe assembly to allow for minor misalignment.
- .8 Manual operating mechanism with:
 - .1 Offset bearings, as required.

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- .2 Pipe shaft.
- .3 Pipe guides.
- .4 Pipe couplings.
- .5 Position indicator.
- .6 Foot bearing.
- .7 Operating handle with key interlock.

2.3 PRIMARY FUSES

- .1 Disconnect vertical 180 degrees opening type.
- .2 Voltage rating: 25 kV.
- .3 Continuous current rating: 175 A.
- .4 Three phase symmetrical short circuit ratings:
- .5 Refill unit consisting of:
 - .1 Fusible element: silver.
 - .2 Arcing rods: main rod copper, silver clad, auxiliary rod stainless steel.
 - .3 Solid material arc-extinguishing medium contained in filament wound glass-epoxy tube.
- .6 Tools: Provide all tools required for installation and removal of fuses.
- .7 Spares: Provide three (3) 25 kV, 175A fuses.

Part 3 Execution

3.1 EXAMINATION

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for outdoor load break switches and fuses installation in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate in presence of Consultant.
 - .2 Inform Consultant 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 Consultant.

3.2 INSTALLATION

- .1 Install in accordance with manufacturer's instructions.
- .2 Locate, mount and connect fuses.

3.3 FIELD QUALITY CONTROL

- .1 Perform tests in accordance with Section 26 05 00 - Common Work Results for Electrical.
- .2 Energize and load feeders controlled by load break switches.

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- .3 Open and close load break switches at least ten times to ensure proper mechanical and electrical performance of installation.
- .4 Check fuse and switch contact resistance with low resistance meter.
 - .1 Do not use more than rated current on fuse.
- .5 Megger switch across each pole, from pole to pole, and from pole to ground.

3.4 CLEANING

- .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment.

END OF SECTION

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Part 1 General

1.1 SUMMARY

- .1 Section Includes:
 - .1 Materials, applications, installation and verification for excavating, trenching and backfilling.

1.2 REFERENCES

- .1 City of Winnipeg (CW).
 - .1 CW3110 – Sub-Grade, Sub-Base, and Base Course Construction.
 - .2 CW3170 – Earthwork and Grading
 - .3 CW3230 – Full-Depth Patching of Existing Slabs and Joints.
- .2 American Society for Testing and Materials International (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 D422-63, Standard Test Method for Particle-Size Analysis of Soils.
 - .4 ASTM D698, Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort.
 - .5 ASTM D1557, Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort.
 - .6 ASTM D4318, Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils.
- .3 Canadian General Standards Board (CGSB).
 - .1 CAN/CGSB-8.1, Sieves, Testing, Woven Wire, Inch Series.
 - .2 CAN/CGSB-8.2, Sieves, Testing, Woven Wire, Metric.
- .4 Canadian Standards Association (CSA International).
 - .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 CAN/CSA-A23.1/A23.2, Concrete Materials and Methods of Concrete Construction/Methods of Test for Concrete.

1.3 DEFINITIONS

- .1 Rock: any solid material in excess of 1 m³ and which cannot be removed by means of heavy duty mechanical excavating equipment with 0.95 to 1.15 m³ bucket. Frozen material not classified as rock.

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- .2 Common excavation: excavation of materials of whatever nature, which are not included under definitions of rock excavation.
- .3 Unclassified excavation: excavation of deposits of whatever character encountered in Work.
- .4 Topsoil:
 - .1 Material capable of supporting good vegetative growth and suitable for use in top dressing, landscaping and seeding.
 - .2 Material reasonably free from subsoil, clay lumps, brush, objectionable weeds, and other litter, and free from cobbles, stumps, roots, and other objectionable material larger than 25 mm in any dimension.
- .5 Waste material: excavated material unsuitable for use in Work or surplus to requirements.
- .6 Borrow material: material obtained from locations outside area to be graded, and required for construction of fill areas or for other portions of Work.
- .7 Unsuitable materials:
 - .1 Weak, chemically unstable, and compressible materials.
 - .2 Frost susceptible materials:
 - .1 Fine grained soils with plasticity index less than 10 when tested to ASTM D4318, and gradation within limits specified when tested to ASTM D422 and ASTM C136:
 - .2 Coarse grained soils containing more than 20 % by mass passing 0.075 mm sieve.
- .8 Sub-grade – the natural in-situ material.
- .9 Sub-base – where required, the layer of material provided between the sub-grade and the base course.
- .10 Base course – the layer of material immediately underlying the pavement

1.4 SUBMITTALS

- .1 Upon request, submit material test results to the Contract Administrator a minimum of two weeks before excavation begins.

Part 2 Products

2.1 MATERIALS

- .1 Sub-Base Materials
 - .1 Sub-base material of the type(s) as shown on the Drawings or indicated in the Specifications.
 - .2 Suitable site sub-base material will be of a type approved by the Contract Administrator.

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- .3 Clay borrow sub-base material will be of a type approved by the Contract Administrator.
- .4 Crushed sub-base material will be crushed aggregate, crushed limestone or crushed concrete pavement.
- .5 Crushed sub-base material will be well-graded and conform to the following grading requirements:

Canadian Metric <u>Sieve Size</u>	Percent of Total Dry Weight Passing each Sieve		
	<u>50 mm max.</u>	<u>100 mm max.</u>	<u>150mm max.</u>
150 000		90-100%*	
100 000	3197-100%	75-90%	
50 000	100%		
25 000		30-50%	50% max.
5 000	25-80%		
80	5-18%	5% max.	

* The maximum allowable size is 300mm.

- .6 150 mm crushed limestone material when subjected to the abrasion test will have a loss of not more than 40% when tested in accordance with grading 1 of ASTM C535, Test for Resistance to Degradation of Large-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine.
- .7 50 mm crushed limestone material when subjected to the abrasion test will have a loss of not more than 40% when tested in accordance with grading A of ASTM C131, Test for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine.
- .8 Crushed concrete sub-base material will be a mixture of reclaimed Portland Cement concrete and asphaltic concrete. The contents of the material will be limited to the following percentages based on weight.
 - .1 minimum of 85% recycled Portland Cement concrete
 - .2 maximum of 15% recycled asphaltic concrete
 - .3 maximum of 3% clay
 - .4 maximum of 1% foreign material

.2 Base Course Materials

- .1 Base course material will be approved by the Contract Administrator.
- .2 Base course material will consist of sound, hard, crushed rock or crushed gravel and will be free from organic or soft material that would disintegrate through decay or weathering.

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- .3 The base course material will be well graded and conform to the following grading requirements:

Canadian Metric <u>Sieve Size</u>	Percent of Total Dry Weight Passing each Sieve	
	<u>Granular</u>	<u>Crushed Limestone</u>
25 000	100%	
20 000	80-100%	100%
5 000	40-70%	40-70%
2 500	25-50%	25-60%
315	13-30%	8-25%
80	5-15%	6-17%

- .4 Base course material when subjected to the abrasion test will have a loss of not more than 35% when tested in accordance with grading B of ASTM C131, Test for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine.

- .5 The material passing the 315 sieve will have a liquid limit not greater than 25 and a plasticity index not greater than 6.

- .6 Where base course is being placed under an asphaltic concrete pavement, the aggregate retained on a No. 5 000 sieve will contain not less than 35% crushed aggregate as determined by actual particle count. Crushed aggregate will be considered as that aggregate having at least one fractured face.

.3 Asphalt Cuttings for Base Course Material

- .1 Asphalt cuttings produced from planing of asphalt pavements or overlays in accordance with CW 3450 may be used as a base course material where indicated in the Specifications or as approved by the Contract Administrator.
- .2 Asphalt cuttings will be well graded and have a maximum particle size of 40 mm.

.4 Lime or Portland Cement

- .1 Use either Lime or Type 10 normal Portland Cement for drying the sub-grade.
- .2 Supply Lime in accordance with CSA A82.43.
- .3 Supply Portland Cement in accordance with CSA A5.

.5 Imported Fill Material

- .1 Imported fill material will consist of low to medium plastic clays or mixtures of sand and clay, uniform in texture.
- .2 The fill material shall be free of wood, vegetation, concrete rubble or stones larger than 25 mm in diameter.

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Part 3 Execution

3.1 SITE PREPARATION

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

3.2 EXCAVATION

- .1 Excavate in-situ material to the depth to accommodate the pavement structure as shown on the Drawings or as directed by the Contract Administrator.
- .2 Stockpile suitable in-situ material and suitable site sub-base material at locations on site as directed by the Contract Administrator.
- .3 Hand trim, make firm and remove loose material and debris from excavations.
 - .1 Where material at bottom of excavation is disturbed, compact foundation soil to density at least equal to undisturbed soil.
- .4 Dispose of surplus suitable site material and unsuitable material such as frost heaving clays, silts, rocks and rubble as per Section 3.2.5.
- .5 Strip and stockpile topsoil from the site in a manner which will prevent contamination of topsoil with underlying soil materials. Stockpile the stripped topsoil at locations on site for later use.
- .6 The limits of excavation will be taken as a vertical plane 450 mm beyond the limits of the proposed pavement except when slip form paving equipment is specified for placement of the concrete pavement, the limits of excavation will be increased to a vertical plane 750 mm beyond the limits of the proposed pavement.
- .7 During excavation, the Contractor will be advised by the Contract Administrator as to which areas have an unsuitable sub-grade. Extend the excavation either to the lower limit of the unsuitable material or to a depth as directed by the Contract Administrator.
- .8 Remove wooden poles, concrete bases, or tree stumps encountered under pavements to the top of subgrade or 1 m below the bottom of the pavement surface, whichever depth is greater.
- .9 Backfill and compact over-excavated areas with sub-base material approved by the Contract Administrator.
- .10 Excavate additional material beyond the boulevard grading and ditch grading limits as directed by the Contract Administrator.
- .11 **Use soft dig excavation methods when within 2 meters of suspected buried cabling. It is expected that the majority of excavation work around poles and transformer pads at the site will be via soft dig methods.**

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3.3 PREPARATION OF SUB-GRADE AND PLACEMENT OF SUB-BASE

- .1 Compact the sub-grade after the bottom of the excavation has been approved by the Contract Administrator.
- .2 Compact areas of suitable sub-grade material, the full width of the excavation, to a minimum of 95% Standard Proctor Density.
- .3 Place and compact suitable site sub-base material before placing any new sub-base material, as directed by the Contract Administrator.
- .4 Place and compact crushed sub-base material with or without geogrid as directed by the Contract Administrator in accordance with CW 3135.
- .5 Place and compact sub-base materials in layers to a depth of 3 times the maximum aggregate size or as directed by the Contract Administrator. Compact to a minimum of 100% Standard Proctor Density, for the full width of the excavation, and each layer must be leveled and approved by the Contract Administrator before the succeeding layer may be placed.
- .6 Layering, mixing or blending of crushed concrete with crushed aggregate or crushed limestone sub-base materials is not allowed.
- .7 Recompect or replace any layer, which has been rejected as directed by the Contract Administrator.
- .8 When excess water has been applied, either by sprinkling operations or by precipitation, to cause local or continuous pondage, soil compaction will not be permitted until sufficient soil drying has occurred, creating a condition lending itself favourably to compacting operations. Exercise necessary precautions to protect compacted areas against excess wetting from any natural or artificial sources of water application.
- .9 Should excess moisture from continuous or heavy precipitation threaten to unduly delay the completion of the Contract. Apply in writing to the Contract Administrator requesting permission to use Lime or Portland Cement to dry out the clay sub-grade or sub-base material at specific location(s).

3.4 PLACEMENT OF BASE COURSE MATERIAL

- .1 Place and compact base course material to a minimum 75 mm thickness for pavement and approaches to a minimum of 100% Standard Proctor Density for the full width of the excavation unless otherwise shown on the Drawings or as directed by the Contract Administrator.
- .2 Level the compacted base course to the finished base course elevation.
- .3 Maintain the finished base course until the pavement is placed.
- .4 Place and compact base course material as a levelling course to a maximum thickness of 50 mm for sidewalks and miscellaneous concrete slabs, to 90% Standard Proctor Density.

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- .5 Place and compact base course material immediately beneath pavement forms to provide firm support.

3.5 PLACEMENT OF IMPORTED FILL

- .1 Place fill materials to satisfy the grading requirements of boulevard and ditches.
- .2 Supply material in accordance with Section 2.5 of this specification.
- .3 Compact to a minimum of 90% Standard Proctor Density.

3.6 GRADING

- .1 Grading of areas to receive sod will be understood to mean the required excavation or backfilling to a depth up to 150 mm so that the areas medians, after compaction, are at a uniform depth of 100 mm below finished grade shown on the Drawings.
- .2 Grade the areas to receive sod, unless otherwise shown on the Drawings or as directed by the Contractor Administrator.
- .3 Remove all debris, stones and concrete rubble from the boulevards and medians before commencing grading.
- .4 Excavate to a depth of up to 150 mm to meet the final grade 100 mm below finished boulevard grade.
- .5 Place and compact suitable backfill material as approved by the Contract Administrator to a depth of up to 150 mm to meet the final grade 100 mm below finished boulevard grade.
- .6 Supply backfill material in accordance with Section 2.1 of this specification.
- .7 Compact backfill materials to a minimum of 90% Standard Proctor Density.

3.7 QUALITY OF SUB-GRADE, SUB-BASE, AND BASE COURSE LAYERS

- .1 Determine the Standard Proctor Density for the sub-grade, sub-base and base course materials at the optimum moisture content in accordance with ASTM Standard D698. The field density of each sub-grade, sub-base and base course layers will be a percentage of the applicable Standard Proctor Density, in accordance with in Sections 3.3, 3.4 and 3.5 of this specification.
- .2 Utilize quality control tests to determine the acceptability of the sub-grade, sub-base and base course layers, as placed and compacted before the succeeding layer may be applied.
- .3 Verify the field density of the compacted layers by Field Density Tests in accordance with ASTM Standard D1556, Test for Density of Soil in Place by the Sand-Cone Method, or ASTM Standard D2922, Test of Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).
- .4 The frequency and number of tests will be as directed by the Contract Administrator.

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- .5 Fill promptly, holes made by the removal of samples from the layers with appropriate material and thoroughly compact so as to conform in every way with the adjoining material.

3.8 DEWATERING AND HEAVE PREVENTION

- .1 Keep excavations free of water while Work is in progress.
- .2 Protect open excavations against flooding and damage due to surface run-off.
- .3 Dispose of water in a manner not detrimental to public and private property, or portion of Work completed or under construction.
 - .1 Provide and maintain temporary drainage ditches and other diversions outside of excavation limits.

3.9 BACKFILLING

- .1 Vibratory compaction equipment is required.
- .2 Do not proceed with backfilling operations until completion of following:
 - .1 The Contract Administrator approved installations construction below finished grade.
 - .2 Inspection, testing, approval, and recording location of underground utilities.
 - .3 Removal of concrete formwork.
 - .4 Removal of shoring and bracing; backfilling of voids with satisfactory soil material.
- .3 Areas to be backfilled to be free from debris, snow, ice, water and frozen ground.
- .4 Do not use backfill material which is frozen or contains ice, snow or debris.
- .5 Place backfill material in uniform layers not exceeding 150 mm compacted thickness. Compact each layer before placing succeeding layer.
- .6 Backfilling around installations.
 - .1 Place bedding and surround material as specified elsewhere.
 - .2 Do not backfill around or over cast-in-place concrete within 48 hours after placing of concrete.
 - .3 Place layers simultaneously on both sides of installed Work to equalize loading. Difference not to exceed 150 mm.
- .7 Install drainage system in backfill as directed by The Contract Administrator.

3.10 RESTORATION

- .1 Prior to construction, inspect the grassed, pavement and gravel surfaces within and adjacent to the Site with the Contract Administrator to record the current condition. After construction and site cleanup is complete, re-inspect the condition with the Contract Administrator.
- .2 Restoration of grassed areas removed or damaged as result of construction activities will be restored in accordance with CW 3510. Restoration of grassed areas will not be measured for payment and shall be included as part of the Work being done.

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- .3 Pavement damaged or removed as a result of construction activities will be restored in accordance with CW3230 and CW 3410. Restoration of the pavement will not be measured for payment and shall be included as part of the Work being done.

END OF SECTION