



# UTILITY GENERATOR DESIGNS

TOWN OF CORNWALL, PEI

TENDER DOCUMENTS  
AND SPECIFICATIONS

SEPTEMBER 2023

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**Utility Generator  
Designs  
Cornwall, PEI**

**Special Provisions  
September, 2023**

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1. All correspondence and questions related to this work during tender period shall be directed to WSP, 195 MacEwen Road, Summerside, PE C1N 5Y4 or phone 902-436-2669 or email [colin.maceachern@wsp.com](mailto:colin.maceachern@wsp.com).
2. Unit prices quoted are to include all applicable taxes, excluding HST, which is to be added in the provided space on the Schedule of Unit Prices. FINAL BID PRICE MUST INCLUDE HST.
3. No extra work will be allowed to proceed without the execution of a change order signed by the Town of Cornwall or their representative and the Contractor, specifying work to be conducted and a fixed cost for said work.
4.
  - a) The Tenderer shall fill in their own schedule showing the number of weeks of construction activity planned. Tenderers are advised that upon receipt of tenders and construction activity time, the authority will estimate construction costs for each Tenderer's submission dates.
  - b) Extension of Time - An extension of time may be granted in writing by the Owner in the event of the work being delayed due to a change of scope in the work, a significant unit quantity increase, loss of production due to above average weather conditions, delays in material supplied by others and any other causes beyond the Contractor's control. Such extensions shall be for such time as the Owner may prescribe, and the Owner shall fix the terms on which the said extension may be granted. An application by the Contractor for an extension of time as herein provided shall be made to the Owner in writing prior to the end of the specified contract time. Where applicable, all bonds or other surety furnished to the Owner by the Contractor shall be amended where necessary at the expense of the Contractor to provide coverage beyond the date of any extension of time granted, and the Contractor shall furnish the Owner with evidence of such amendment of the bonds or other surety.  
  
Any extension of time that may be granted and accepted without prejudice to any rights of the Owner whatsoever under the Contract. All such rights shall continue to be in full force and in effect after the specified construction period.
  - c) Liquidated Damages - The Contractor shall pay liquidated damages for each working day beyond the number of working days as specified in the Contract or beyond any extension of time that may be granted in accordance with 20(b) above.

The liquidated damages shall be equivalent to the costs incurred by the Owner for each day beyond the scheduled time of completion. All above monies shall be deducted from progress claims (ie. consultant fee, supervisor salaries, overhead

- vehicle cost, etc.)
5. Upon final inspection and testing, if any part of any components that do not meet project specifications, the following shall occur:
    - a) The Contractor shall immediately remove all components that do not meet project specifications and replace them with materials that do meet project specifications at no additional cost to the Owner; or,
    - b) The Contractor shall make arrangements with the Owner so as to satisfy the Owner that no short- or long-term negative consequences will occur as a result of the components not meeting specifications. If the Contractor cannot satisfy the Owner of these requirements, then all components that do not meet project specifications shall be removed and replaced by the Contractor at no additional costs to the Owner;
    - c) All costs associated with non-compliance with specifications, including testing materials, labour and engineering, will be the Contractor's responsibility.
  6. The Contractor is advised that a Certificate of Substantial Completion will only be issued following the Contractor successfully completing all required project work and as-built drawings. Upon submission of these items to the Engineer, the Substantial Completion will be at the approval of the Engineer.
  7. The Contractor is advised that project drawings are to be considered as a reasonable reflection of existing surface conditions only, and that underground conditions will vary and that non-detected or unforeseen items are to be expected (ie., unexpected buried pipes, excessive groundwater or rock, utilities lines, etc.). If existing conditions vary in such a manner as to severely impede progress or cause a complete halt to construction activities, notify the Site Engineer immediately for further direction.
  8. The Contractor is advised that there is a requirement to provide the Engineer and Owner with all Layout and Record Drawings.
  9. The Contractor is advised that all project record drawings must be to the satisfaction of the Engineer.

**1 GENERAL**

Sealed tenders for the work proposed shall be addressed to the Town of Cornwall and plainly marked:

**Utility Generator Designs  
Cornwall, PEI**

Tenders will be received by the Town of Cornwall between 11:00AM and 1:00PM, on the date specified in the tender ad, at the Town Office located at 15 Mercedes Drive, Cornwall, PEI.

**2 TENDER DEPOSIT**

Every Tender received shall be accompanied by a certified cheque, bank draft or bid bond payable to the Town of Cornwall in the amount of at least Ten Percent (10%) of the tender price. The deposit of the three lowest Tenders will be retained until a contract has been signed and any necessary bonds/cheques furnished to the satisfaction of the Engineer and Owner. No interest will be paid on any tender deposit.

If a bid bond is issued it must be accompanied by a letter of surety from a recognized Canadian Surety Company outlining that a Fifty Percent (50%) Performance Bond and a Fifty Percent (50%) Labour and Materials Bond will be presented if awarded the project.

All other deposits shall be returned by mail unless otherwise requested by the Bidder.

**3 INTERPRETATION OF  
CONTRACT DOCUMENTS**

Should any person contemplating submitting a tender for the proposed Contract find discrepancies in or omissions from the drawings, specifications, or other parts of the contract documents, or should he be in doubt as to their true meaning, or if he requires additional information concerning the scope of work or the manner in which it must be carried out, he may submit a written request to the Engineer for interpretation a minimum of two clear days prior to tender closing. Any conflict between drawings, specifications and authoritative requirements, the most stringent interpretation will apply.

These design documents are prepared solely for the use by the party with whom the design professional has entered into a contract and there are no representations of any kind made by the design professional to any party with whom the design professional has not entered into a contract.

**4 WITHDRAWAL OR QUALIFY-  
ING OF TENDERS**

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A Bidder who has already submitted a tender may submit a further tender at any time up to the official closing time. The last tender received shall supersede and invalidate all tenders previously submitted by that Bidder for this Contract. Any Bidder may withdraw or qualify his tender at any time up to the official closing time by submitting a letter bearing his signature and seal as in his tender to the Owner the time and date of receipt will be marked thereon and the letter will be placed in the tender box. The new tender shall be marked on the sealed envelope by the Bidder as "Resubmission #" along with the name of the Bidder and to the attention of the Controller. Tenders may be withdrawn at any time prior to opening upon written request from the Bidder. Negligence on the part of the Bidder in preparing his/her tender shall not constitute a right to withdraw a tender subsequent to the tender opening

No fax or email submission will be considered. All entries in the Form of Tender shall be made in ink or by typewriter. Entries and changes made in pencil shall, unless otherwise decided by the Owner, be invalid or informal.

**5 INFORMAL OR UNBAL-  
ANCED TENDERS**

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Tenders that contain prices which appear to be so unbalanced as likely to affect adversely the interests of the Owner may be rejected. Wherever, in a tender that amount tendered for an item does not agree with the extension of the estimated quantity and the tendered unit price, the unit price shall govern and the amount shall be corrected accordingly. If a Bidder has not entered a price for an item or work set out in the Form of Tender, he shall, unless he has specifically stated otherwise in his tender, be deemed to have allowed elsewhere in the Form of Tender for the cost of carrying out the said item or work, unless agreed by the Owner no increase shall be made in the Total Tender Price on account of such omission.

**6 EXAMINATION OF SITE**

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Each Bidder shall personally examine the location of the proposed work, and shall satisfy himself by such other means as he may prefer as to the actual conditions and requirements under which the work shall be carried out.

No plea for ignorance of conditions that exist or that may hereafter exist or of conditions or difficulties that may be encountered in the execution of the work under this Contract as a result of failure to make the necessary examinations and investigations shall be accepted as an excuse for any failure or omission on the part of the Contractor to fulfil in every detail all the requirements of said Contract Documents or shall be accepted as a basis for any claim whatsoever for extra compensation or an extension of time.

The Bidder shall also make all the investigations necessary to thoroughly inform himself regarding all facilities for access to the site that he may require for storage and construction operation.

## **7 TENDER FORM**

All submissions shall be upon the blank Form of Tender enclosed, and be signed by the Bidder with his business address and place of residence. All blank spaces which pertain to the Tender submitted shall be filled in by typewriter, or legible printing in ink except signatures, which must be handwritten.

## **8 PRICE SUBMITTED**

The amounts stated in the Tender Form shall include the furnishing of all materials, supplies and equipment and the providing of all labour, construction tools and equipment, utility and transportation services necessary to complete all the work required under this Contract whether specifically included in the Contract Documents or not. It is the intention of the Drawings and Specifications to provide finished work. Any items omitted therefrom which are clearly necessary for the completion of the work or its appurtenances shall be considered a portion of the work though not directly and/or shown or called for on the Drawings.

## **9 SUB-CONTRACTORS**

The Bidders shall give in the Form of Tender the name and address of each proposed sub-contractor used in making up his tender as set out in the Tender Form. Only one sub-contractor shall be named for each part of the work to be sublet. The Town reserves the right to accept or reject sub-contractors.

## **10 RIGHT TO ACCEPT OR REJECT TENDERS**

Bidders are advised that:

The lowest or any particular bid will not necessarily be accepted.

The criteria to be considered by the Owner in awarding the contract will include a combination of price, scheduling, expertise, qualifications and such other conditions as may be determined by the Owner to be in its own best interests.

Additions, alterations, deletions or other irregularities in the bid form may, but will not necessarily, result in the Owner's rejection of the bid.

The bidder acknowledges that it shall have no claim against, or entitlement to damages from, the owner by reason of the Owner's rejection of its bid or of all bids.

**11 CANCELLATION OF TENDER**

The Owner reserves the right to cancel any request for tender at any time, without recourse by the Contractor. The Owner has the right to not award this work for any reason, including choosing to complete the work with the Owner's own forces.

**12 CONTRACT DEPOSITS**

The Contractor must provide the following performance deposit: Certified cheque(s), or bank draft payable to the Town of Cornwall in the amount of Ten Percent (10%) of the contract price or a Performance Bond **and** a Materials and Labour Bond both in the amount of Fifty Percent (50%) of the contract price payable to the Town of Cornwall. Deposit(s) shall be required during the contract period until the issuance of the Final Certificate of Completion. Certified cheques and bank drafts will be held, uncashed, by the Owner and no interest will be paid. Performance deposit will be released upon Final Completion of the work to the Engineer's approval. A Fifteen Percent (15%) Holdback will be retained during construction and for Sixty (60) days following substantial completion as the Owner's protection during the standard lien period.

**13 SCHEDULE**

A detailed schedule of the work may be provided with the tender package and will be reviewed in conjunction to the tendered price and completion time during tender evaluation. If a detailed schedule is not submitted with the tender package, one must be provided prior to award.

**14 SALES TAX**

Contractor is to include all applicable Harmonized Sales Taxes (HST). It is the intention of the Owner to claim a credit for these taxes. Therefore, all information pertaining to taxes required by the Owner will be made available by the Contractor.

The HST shall be shown separately in the Schedule of Unit Prices in the provided space. This amount must be added to the subtotal to result in a total tender amount.

**15 GUARANTEED MAINTENANCE PERIOD**

A guaranteed maintenance period shall be effective for a total of twelve (12) months, specified from the day following substantial completion. Five Percent (5%) of all monies shall be retained by the owner during construction and for twelve (12) months following substantial completion. This 5% shall be retained as security for the owner to be utilized by the owner if the contractor fails to provide adequate service during the maintenance period.



All engineering costs incurred by the Owner resulting from inadequate service by the Contractor (ie., non-responsive to deficient items requiring repair or repeated repairs to the same item), will be deducted from the Guaranteed Maintenance Holdback.

**NOTE: Guaranteed Maintenance Holdback is in addition to the Fifteen Percent (15%) Mechanic's Lien Holdback.**

## **16 ADDENDA**

1. The Town reserves the right at any time prior to the award of the Contract, to make changes and/or revisions that are considered altering the intent of this Tender. Any changes and/or revisions will be issued as an Addendum.
2. The Town, in consultation with the Consultant, will review all questions and issue written instructions in the form of an Addendum, which will become part of the Contract documents. All Addenda must be acknowledged on the Form of Tender.
3. The closing date of the Request for Tender may be extended as deemed appropriate by the Town.
4. It is a Bidder's sole responsibility to ensure that it has accounted for all Addenda or other notices of change or alteration of the Tender in their submission and in any price proposed therein. All Addenda will be posted at:  
<https://www.princeedwardisland.ca/en/tenders>.
5. The Town shall not be liable for any expense, cost, loss or damage incurred or suffered by any Bidder as a result of the publication of an Addendum or other notice.

## **17 ASSIGNMENT**

This tender, and any resulting contract, may not be assigned by either party without the prior written consent and approval of the other party, which consent may not be unreasonably withheld; provided, however, either party, without such consent, may assign or sell the same in connection with the transfer or sale of substantially its entire business to which this contract pertains or in the event of its merger or consolidation with another company. Any permitted assignee shall assume all obligations of its assignor under this contract. No assignment shall relieve any part of responsibility for the performance of any accrued obligation that such party then has hereunder.

**TENDER FORM FOR  
UTILITY GENERATOR DESGINS**

**CORNWALL, P.E.I.**

TO: TOWN OF CORNWALL  
15 MERCEDES DRIVE  
CORNWALL, PE  
COA 1H0

\_\_\_\_\_ (Name of Tenderer)

having carefully examined the site of the proposed works and all documents relating thereto, including the Form of Tender, Instructions to Bidders, General Conditions, Specifications, Drawings, accept and agree to the same as forming part and parcel of the Contract for the work described in these documents, and we the undersigned hereby tender and offer, in accordance with the said documents, to enter into a Contract with the Town of Cornwall, defined as the Owner, within the time prescribed, to furnish all materials, labour, equipment, matters and things, and to do all work necessary to construct, complete and ready for use within the time stated, in strict accordance with the documents pertaining to the said Contract for the total sum of

\_\_\_\_\_ Dollars  
(\$\_\_\_\_\_)

or such other sum as may be ascertained in accordance with the Contract. The aforesaid sum is made up as stated in appended Tender Price Breakdown forming part of this Tender and includes all costs, including but not limited to, Harmonized Sales Tax on materials to be incorporated into the work.

WE ENCLOSE HEREWITH: A deposit of Ten Percent (10%) of the tendered amount in the form of a certified cheque or bid bond issued by a Company licensed to carry on such business in Canada.

In the event of this tender being accepted within 60 days of the time stated for the closing of receipt of tenders, and our failing or declining to enter into a contract in the form hereinafter mentioned for the amount of our tender, the said security may be forfeited in lieu of damages to which the Owner may be entitled by reason of our failure or refusal to enter into a contract.

IN SUBMITTING THIS TENDER, we recognize the right to the Owner to accept any tender at the prices submitted, or to reject all tenders.

WE SUBMIT HEREWITH a list of trades we propose to execute ourselves:

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WE SUBMIT HEREWITH a list of sub-contractors we propose to use on this contract, reserving to us, however, the right to substitute other sub-contractors for any trades in the event of any sub-contractor withdrawing his tender or becoming bankrupt after the date hereof. Any such substitution shall be subject to the prior approval of the Owner.

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IF WE ARE NOTIFIED OF THE ACCEPTANCE OF THIS TENDER WITHIN THE TIME ABOVE SPECIFIED, WE WILL:

- a) Execute the most recent edition of the "Standard Construction Document" CCDC-4 (Unit Price Contract).
- b) Furnish a Ten Percent (10%) Certified Cheque as Performance Deposit or a Fifty Percent (50%) Performance Bond and a Fifty Percent (50%) Labour and Materials Bond.
- c) Commence work on the \_\_\_\_ day of \_\_\_\_\_, 20\_\_\_\_, and complete the entire work included in the contract on or before the \_\_\_\_ day of \_\_\_\_\_, 20\_\_\_\_, resulting in a total number of \_\_\_\_\_ construction weeks.

Yours truly,

\_\_\_\_\_  
Name (printed)

\_\_\_\_\_  
Signature

\_\_\_\_\_  
Name (printed)

\_\_\_\_\_  
Signature

**SCHEDULE OF UNIT PRICES  
UTILITY GENERATOR DESIGNS  
TOWN OF CORNWALL**

**Part 1: Riverpoint Water Station**

<u>Item #</u>	<u>Description</u>	<u>Quantity</u>	<u>Unit Price</u>	<u>Total Price</u>
1.	25kW Diesel Generator: Including weatherproof and soundproof enclosure and sub-base fuel tank.	1 L.S.	\$_____	\$_____
2.	100 Amps Automatic Transfer Switch	1 L.S.	\$_____	\$_____
3.	Conduits	1 L.S.	\$_____	\$_____
4.	Cable: Power	50 m	\$_____	\$_____
5.	Power & Control Cables: 10 to 14 AWG	1 L.S.	\$_____	\$_____
6.	Panel Modification	1 L.S.	\$_____	\$_____
7.	New Breakers for Battery Charger and Block Heater	1 L.S.	\$_____	\$_____
8.	Remote Annunciator Panel	1 L.S.	\$_____	\$_____
9.	Bollards	18 Ea.	\$_____	\$_____
10.	Grounding: Including four ground rods, one inspection window and ground cable.	1 L.S.	\$_____	\$_____
11.	Concrete Base for Generator.	1 L.S.	\$_____	\$_____
12.	Trenching and Backfill	1 L.S.	\$_____	\$_____
13.	Landscaping	1 L.S.	\$_____	\$_____
14.	Maritime Electric Coordination and Approvals	1 L.S.	\$_____	\$_____
15.	Removal of existing mobile generator connection.	1 L.S.	\$_____	\$_____

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<u>Item #</u>	<u>Description</u>	<u>Quantity</u>	<u>Unit Price</u>	<u>Total Price</u>
16.	Demobilization & Cleanup	1 L.S.	\$_____	\$_____

**Part 2: North River UV Building**

<u>Item #</u>	<u>Description</u>	<u>Quantity</u>	<u>Unit Price</u>	<u>Total Price</u>
1.	25kW Diesel Generator: Including weatherproof and soundproof enclosure and sub-base fuel tank.	1 L.S.	\$ _____	\$ _____
2.	100 Amps Automatic Transfer Switch	1 L.S.	\$ _____	\$ _____
3.	Conduits	1 L.S.	\$ _____	\$ _____
4.	Cable: Power	50 m	\$ _____	\$ _____
5.	Power & Control Cables: 10 to 14 AWG	1 L.S.	\$ _____	\$ _____
6.	Panel Modification	1 L.S.	\$ _____	\$ _____
7.	New Breakers for Battery Charger and Block Heater	1 L.S.	\$ _____	\$ _____
8.	Remote Annunciator Panel	1 L.S.	\$ _____	\$ _____
9.	Bollards	18 Ea.	\$ _____	\$ _____
10.	Grounding: Including four ground rods, one inspection window and ground cable.	1 L.S.	\$ _____	\$ _____
11.	Concrete Base for Generator.	1 L.S.	\$ _____	\$ _____
12.	Trenching and Backfill	1 L.S.	\$ _____	\$ _____
13.	Landscaping	1 L.S.	\$ _____	\$ _____
14.	Maritime Electric Coordination and Approvals	1 L.S.	\$ _____	\$ _____
15.	Removal of existing mobile generator connection.	1 L.S.	\$ _____	\$ _____
16.	Demobilization & Cleanup	1 L.S.	\$ _____	\$ _____

**Part 3: Warren Grove Lift Station**

<u>Item #</u>	<u>Description</u>	<u>Quantity</u>	<u>Unit Price</u>	<u>Total Price</u>
1.	30kW Diesel Generator: Including weatherproof and soundproof enclosure and sub-base fuel tank.	1 L.S.	\$ _____	\$ _____
2.	100 Amps Automatic Transfer Switch	1 L.S.	\$ _____	\$ _____
3.	Conduits	1 L.S.	\$ _____	\$ _____
4.	Cable: Power	50 m	\$ _____	\$ _____
5.	Power & Control Cables: 10 to 14 AWG	1 L.S.	\$ _____	\$ _____
6.	Panel Modification	1 L.S.	\$ _____	\$ _____
7.	New Breakers for Battery Charger and Block Heater	1 L.S.	\$ _____	\$ _____
8.	Remote Annunciator Panel	1 L.S.	\$ _____	\$ _____
9.	Bollards	14 Ea.	\$ _____	\$ _____
10.	Grounding: Including four ground rods, one inspection window and ground cable.	1 L.S.	\$ _____	\$ _____
11.	Concrete Base for Generator.	1 L.S.	\$ _____	\$ _____
12.	Trenching and Backfill	1 L.S.	\$ _____	\$ _____
13.	Landscaping	1 L.S.	\$ _____	\$ _____
14.	Maritime Electric Coordination and Approvals	1 L.S.	\$ _____	\$ _____
15.	Removal of existing mobile generator connection.	1 L.S.	\$ _____	\$ _____
16.	Demobilization & Cleanup	1 L.S.	\$ _____	\$ _____



<u>Item #</u>	<u>Description</u>	<u>Quantity</u>	<u>Unit Price</u>	<u>Total Price</u>
1.	Subtotal Part 1 – River Point Water Station			\$ _____
2.	Subtotal Part 2 – North River UV Building			\$ _____
3.	Subtotal Part 3 – Warren Grove Lift Station			\$ _____
4.	Cash Allowance	1 L.S.		\$ _____
Subtotal =				\$ _____
HST (15%) =				\$ _____
Total Tender Amount (Supplied and Installed) =				\$ _____

Contractor \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_

Signature \_\_\_\_\_

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1. Description of Work
    - .1 The projects are located at the River Point Water Station, the North River Lagoon, and the Warren Grove Lift Station in the Town of Cornwall.
    - .2 The work involves the installation of a Diesel Genset, concrete pad and accompanying electrical upgrades at each of the aforementioned locations in the Town of Cornwall.
  
  2. Documents Required
    - .1 Maintain at job site, one copy of each of the following:
      - .1 Contract Drawings
      - .2 Specifications
      - .3 Addenda
      - .4 Reviewed Shop Drawings
      - .5 Change Orders
      - .6 Other Modifications to Contract
      - .7 Copy of approved Work Schedule
      - .8 Manufacturers' Installation and Application Instructions.
      - .9 Copy of OH&S Regulations for P.E.I.
      - .10 Regulatory Approvals.
  
  3. Work Schedule
    - .1 Prior to contract award, provide a schedule showing anticipated progress stages and final completion of work within time period required by Contract documents.
    - .2 Interim reviews of work progress based on work schedule will be conducted as decided by Engineer and Schedule updated by Contractor in conjunction with and to approval of Engineer.
    - .3 All costs incurred by the Owner as a result of delays and schedule overruns caused by the Contractor and not previously approved will be at the Contractor's expense.
  
  4. Measurement and Payment
    - .1 Notify Engineer sufficiently in advance of operations to permit required measurements for payment.
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5. Contractor's  
Use of Site
- .1 Do not unreasonably encumber site with materials or equipment.
  - .2 Move stored products or equipment which interfere with operations of Engineer or other contractors.
  - .3 Obtain and pay for use of additional storage or work areas needed for operations. Ensure these areas are cleaned up and left in a state equal to or better than the existing conditions, when the project is complete.
6. Codes and  
Standards
- .1 Perform work in accordance with National Building Code of Canada (NBC) (latest edition) and any other code of provincial or local application provided that in any case of conflict or discrepancy, more stringent requirements shall apply.
  - .2 Meet or exceed requirements of specified standards, codes and referenced documents.
7. Setting Out  
Work
- .1 Set grades and lay out work in detail from control points and grades established by the Engineer.
  - .2 Assume full responsibility for and execute complete layout of work to locations, lines and elevations indicated.
  - .3 Supply such devices as straight edges and templates required to facilitate Engineer's inspection of work.
  - .4 Provide devices needed to layout and construct work.
  - .5 Supply stakes and other survey markers required for laying out work.
8. Location of  
Equipment and  
Fixtures
- .1 Location of equipment, fixtures and outlets indicated or specified are to be considered as approximate.
  - .2 Inform Engineer of impending installation and obtain his approval for actual location.
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- .3 Submit field drawings to indicate relative position of various services and equipment when required by Engineer.
9. Existing Services
- .1 Where work involves breaking into, or connecting to existing services, carry out work at times directed by governing authorities.
- .2 Before commencing work, establish location and extent of service lines in area of work and notify Engineer of findings.
- .3 Submit schedule to and obtain approval from Engineer for any shut-down or closure of active service or facility. Adhere to approved schedule and provide notice to affected parties.
- .4 Where unknown services are encountered, immediately advise Engineer.
- .5 All existing utilities damaged during construction shall be repaired by the Contractor, or the utility Owner, at the Contractor's expense, and to the satisfaction of the Engineer.
- .6 Where watermain or sewermain or stormline is in close proximity to existing electric and telephone poles, these poles must be maintained while construction is proceeding. All costs associated with this work should be incorporated into Contractor's price. No extra will be allowed.
10. Existing Surface Conditions
- .1 Where construction may impact any existing surface conditions such as fencing, trees, signs, etc, the Contractor is responsible to replace and/or reinstate to the original condition as approved by the Engineer, at the Contractor's expense.
- .2 All equipment shall be properly equipped to not damage asphalt or concrete surfaces during the project. Any damage to existing surfaces will be reinstated to original condition at the Contractor's expense.
- .3 All asphalt/concrete surfaces which require excavation are to be sawcut prior to excavation.
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11. Inspection/  
Takeover  
Procedures

- .1 Prior to application for Certificate of Substantial Completion, carefully inspect the work and ensure it is complete, that major and minor construction deficiencies are complete, defects are corrected. Notify Engineer in writing, of satisfactory completion of the work and request an inspection.
- .2 During Engineer's inspection, a list of deficiencies and defects will be tabulated. Correct same at the Contractor's expense.
- .3 Upon final inspection and testing, if any part of any component of the project does not meet project specifications, then the following shall occur:
  - (a) The Contractor shall immediately remove all components that do not meet project specifications and replace them with materials that do meet project specifications at no additional cost to the Owner; or,
  - (b) The Contractor shall make arrangements with the Owner so as to satisfy the Owner that no short or long term negative consequences will occur as a result of the components not meeting specifications. If the Contractor cannot satisfy the Owner of these requirements then all components that do not meet project specifications shall be removed and replaced by the Contractor at no additional costs to the Owner.
  - (c) All costs associated with non-compliance with specifications, including testing materials, labour, and engineering will be the Contractor's responsibility.
- .4 When Engineer considers deficiencies and defects have been corrected and it appears requirements of contract have been performed, make application for Certificate of Substantial Completion.

12. Cleaning

- .1 General:
  - .1 Conduct cleaning and disposal operations to comply with local ordinances and anti-pollution laws.

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- .2 Store volatile, wastes in covered metal containers and remove from premises daily.
  - .3 Prevent accumulation of wastes which create hazardous conditions.
  - .4 Provide adequate ventilation during use of volatile or noxious substances.
- .2 Materials:
    - .1 Use only cleaning materials recommended by manufacturer or surface to be cleaned, and as recommended by cleaning material manufacturer.
  - .3 Cleaning during Construction:
    - .1 On a daily basis maintain premises free from debris and waste material.
    - .2 Maintain project site and public properties free from accumulations of waste materials and rubbish.
    - .3 Provide on-site containers for collection of waste materials and rubbish.
    - .4 Remove waste materials and rubbish from site.
  - .4 Final Cleaning:
    - .1 Leave site in clean and neat condition removing all rubbish, excess materials and any items used on site, but designated to remain in the work.
13. Materials .1 All materials to be incorporated into the work will be new and shall comply with the required acceptable materials list unless stated otherwise or agreed to by the Engineer
14. Change Orders .1 No extra will be allowed to proceed without the execution of a Change Order signed by the Owner or the Owner's Representative and the Contractor, specifying the work to be conducted and a fixed cost for said work.
15. Asphalt  
Concrete Surfaces .1 Bidders are advised that all equipment shall be properly equipped not to damage asphalt or concrete surfaces during the project. Any damage to existing surfaces will be reinstated to original condition at the Contractor's expense.
- .2 All asphalt surfaces which require excavation are to be sawcut prior to excavation.
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16. Site Maintenance and Clean-Up
- .1 The Contractor is advised that extra care must be taken during construction, at the end of every day worked and over weekend or shut-down periods, to maintain dust control and site clean-up. Bidders are advised that the minimum daily clean-up requirements will be that all areas affected will be wet down and hand swept or equivalent method as approved by the Engineer.
- .2 As each area is 100% completed, with all mains, services, topsoiling and seeding in place, a complete high-pressure water washing of all affected areas will be required at the Contractor's expense.
- .3 These clean-up items will be strictly enforced. No effort or costs will be incurred by the Owner.
17. Limitation of Operation
- .1 Except for such work as may be required to maintain the travelled roadway in a safe and satisfactory condition for traffic and as noted in .2 below, the Contractor shall not carry out operations under the contract between a ½ hour before sunset and a ½ hour after sunrise, or from 7:00 am to 7:00 pm on any working day, or at any time on Saturday, Sunday, Thanksgiving Day or statutory holidays. The most stringent will apply. This includes the start-up and moving of equipment on the site as well as at the marshaling yard.
- .2 The Engineer may require the Contractor to work on Saturdays, Sundays or statutory holidays to assure the safety of the travelling public. In addition, the Engineer may require the Contractor to work on Saturdays in order to complete the work.
- .3 The Engineer may in writing require the Contractor to cease or limit operations under the Contract, or any working day or days, if the operations are of such nature, or if the work is so located, or if the traffic is of such volume that the Engineer deems it necessary or expedient to do so.
18. Assistance to the Consultant and the Consultant's Representative
- .1 During the performance of the work, provide necessary labour and tools to assist the Engineer and the Engineer's
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Representative in measuring, checking, testing and examining the Contractor's work. The cost of all such being deemed to be incidental to the performance of the contract.

19. Insurance

- .1 The Contractor must furnish the following insurance policies to the satisfaction of the Town of Cornwall prior to commencement of any work.
- .2 The Contractor shall, without limiting its obligations or liabilities herein and at its own expense, provide and maintain the following insurances in forms and amounts acceptable to the Owner.
  - .1 Comprehensive General Liability in an amount not less than \$5,000,000. inclusive per occurrence against bodily injury, death and property damage, with a property damage deductible not exceeding two thousand five hundred dollars (\$2,500.00). The Town of Cornwall, WSP Canada Inc. and the Government of P.E.I. are to be added as an insured under this policy. Such insurance shall include, but not be limited to the following:
    - i. Products and Completed Operations Liability;
    - ii. Owner's and Contractor's Protective Liability;
    - iii. Blanket Written Contractual Liability;
    - iv. Contingent Employer's Liability;
    - v. Personal Injury Liability;
    - vi. Non-owned Automobile Liability;
    - vii. Cross Liability;
    - viii. Employees as Additional Insureds;
    - ix. Broad Form Property Damage; and
    - x. Operation of Attached Machinery;
    - xi. Shoring, blasting, excavating, underpinning, demolition, removal, pile driving and caisson work, work below ground surface, tunnelling and grading as application;
    - xii. Elevator and Hoist Liability'
    - xiii. Sudden and Accidental Pollution Liability;
    - xiv. Fire Fighting Expense Liability.
  - .2 Automobile Liability on all vehicles owned, leased, operated, or licensed in the name of the Contractor in

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an amount not less than \$2,000,000.00.

- .3 All the foregoing insurance shall be primary and not require the sharing of any loss by any insurer of the Town of Cornwall, WSP Canada Inc., and/or the Government of P.E.I. and preclude subrogation by the insurer against the aforementioned parties.
- .4 Proof of Insurance; certified copies of the required insurance, as mentioned, must be presented to the Town of Cornwall at the time of signing of the contract and shall be subject to the Town of Cornwall's approval for adequacy of protection. Approval by the Community of any policy filed by the Contractor shall in no way relieve the Contractor of its obligations to provide the insurance referred to in the contract, nor shall it imply that the policies are in accord with the terms of this agreement.
  - i. All required insurance shall be endorsed to provide the Community 60 days advance written notice of cancellation or material change.
  - ii. All insurances shall be in effect until issuance of the "Certificate of Final Acceptance" and for the duration of the Warranty Period.
  - iii. The Contractor hereby waives all rights of recourse against the Town of Cornwall, WSP Canada Inc., and the Government of P.E.I. with regard to damage to the Contractor's property.
  - iv. The Contractor shall require and ensure that each subcontractor maintain liability insurances comparable to that required above.
  - v. Claims made to policies must have a 3 year extended reporting option on their policy.
  - vi. The Contractor agrees to indemnify and save harmless the Owner and the Owner's Representative from any and all costs, charges or expenses howsoever arising out of any breaches in the insurance coverages or part thereof.
- .5 Property damage deductible shall be two thousand five hundred dollars (\$2,500.00) per occurrence.

19. Traffic Control
    - .1 Provide traffic control in accordance with Temporary Workplace Traffic Control Manual issued by Prince Edward
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Island Transportation, Infrastructure and Energy, and the Manual of Uniform Traffic Control Devices of Canada prepared by the Transportation Association of Canada.

- .2 In urban areas, consult with local authorities having jurisdiction for possible additional or special requirements.
- .3 Meet with local authorities having jurisdiction prior to start of construction to determine allowable diversions of vehicle and pedestrian traffic, and access to construction area.
- .4 Provide traffic control personnel, signals, lights and other traffic control methods where required.
- .5 Provide and maintain signs, delineators, barricades, barriers, and miscellaneous warning devices to indicate construction activities or other temporary and unusual conditions.

20. Occupational  
Health and Safety

- .1 This contract will comply with the regulations of the PEI Occupational Health and Safety Act and any other regulations pertaining to the construction and maintenance of the work. The company awarded this contract will be required to provide proof that their Company complies with all the provision of the PEI Occupational Health and Safety Act, as well as the PEI Workers Compensation Act regulations. During the process of the quoted work Companies will be required, on the request of the Town of Cornwall, to provide written verification that their work is on compliance.
- .2 All Contractors must have an identified Safety Representative for the project. This safety representative will be the person to which WSP and/or the Town of Cornwall will give notice of any perceived safety issues and if the issue(s) is not rectified in a timely fashion, then the Provincial Occupational Health and Safety will be notified.
- .3 Please note, WSP and the Town of Cornwall are not acting as the Contractor's Safety Representative, and do not accept responsibility of any safety issues that go unnoticed or unreported by WSP and/or the Town of Cornwall. The responsibility still remains with the Contractor and it is the Contractor's responsibility to have knowledge of the safe working practices required by OH&S and their company safety policy where one exists.



**Part 1 General****1.1 WORK COVERED BY CONTRACT DOCUMENTS**

- .1 Work of this Contract includes installation of a new Diesel generator and automatic transfer switch at the River Point Water Station, North River UV Building, and the Warren Grove Lift Station.
- .2 The scope of work shall include:
  - Install new generator and automatic transfer switch.
  - The new generators shall be installed on a concrete base. The automatic transfer switches shall be installed as per design drawings. While installing the transfer switch, ensure that temporary back-up power is provided. Temporary provision for power, if required, is to be made available. All power and control cables shall be installed for a complete functioning system.
- .3 Work of this Contract shall include the supply and installation of diesel generator, transfer switch and all associated accessories.

**1.2 CONTRACT METHOD**

- .1 Construct Work under a single stipulated price contract.

**1.3 WORK BY OTHERS**

- .1 Cooperate with other Contractors in carrying out their respective works and carry out instructions.
- .2 Coordinate work with that of other Contractors. If any part of work under this Contract depends for its proper execution or result upon work of another Contractor, report promptly to Representative, in writing, any defects which may interfere with proper execution of Work.

**1.4 WORK SEQUENCE**

- .1 Construct Work in stages to accommodate Owner's continued use of premises during construction.
- .2 Coordinate Progress Schedule and coordinate with Representative.
- .3 Construct Work in stages to provide for continuous public usage. Do not close off public usage of facilities until use of one stage of Work will provide alternate usage.
- .4 Maintain fire access/control.

**1.5 CONTRACTOR USE OF PREMISES**

- .1 Limit use of premises for Work and for access, to allow:
  - .1 Owner occupancy.

- .2 Partial owner occupancy.
- .3 Work by other contractors.
- .4 Public usage.
- .2 Coordinate use of premises under direction of Representative.
- .3 Obtain and pay for use of additional storage or work areas needed for operations under this Contract.
- .4 Remove or alter existing work to prevent injury or damage to portions of existing work which remain.
- .5 Repair or replace portions of existing work which have been altered during construction operations to match existing or adjoining work, as directed by Representative.
- .6 At completion of operations condition of existing work: equal to or better than that which existed before new work started.

## **1.6 OWNER OCCUPANCY**

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

## **1.7 ALTERATIONS, ADDITIONS OR REPAIRS TO EXISTING BUILDING**

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

## **1.8 EXISTING SERVICES**

- .1 Notify Representative and utility companies of intended interruption of services and obtain required permission.
- .2 Submit schedule to and obtain approval from Representative for any shut-down or closure of active service or facility including power and communications services. Adhere to approved schedule and provide notice to affected parties.
- .3 Provide temporary services when directed by Representative to maintain critical building and tenant systems.
- .4 Provide adequate bridging over trenches which cross sidewalks or roads to permit normal traffic.
- .5 Where unknown services are encountered, immediately advise Representative and confirm findings in writing.
- .6 Protect, relocate or maintain existing active services. When inactive services are encountered, cap off in manner approved by authorities having jurisdiction.

- .7 Record locations of maintained, re-routed and abandoned service lines.

## **1.9 DOCUMENTS REQUIRED**

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

### **Part 2 - Products**

#### **2.1 NOT USED**

- .1 Not used.

### **Part 3 - Execution**

#### **3.1 NOT USED**

- .1 Not used.

**-- END OF SECTION --**

**Part 1 - General****1.1 RELATED REQUIREMENTS****1.2 ADMINISTRATIVE**

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

**1.3 SHOP DRAWINGS AND PRODUCT DATA**

- .1 Submissions include:
  - .1 Date and revision dates.
  - .2 Project title and number.
  - .3 Name and address of:
    - .1 Subcontractor.
    - .2 Supplier.
    - .3 Manufacturer.
  - .4 Contractor's stamp, signed by Contractor's authorized representative certifying approval of submissions, verification of field measurements and compliance with Contract Documents.
  - .5 Details of appropriate portions of Work as applicable:
    - .1 Fabrication.

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- .2 Layout, showing dimensions, including identified field dimensions, and clearances.
    - .3 Setting or erection details.
    - .4 Capacities.
    - .5 Performance characteristics.
    - .6 Standards.
    - .7 Relationship to adjacent work.
  - .2 After Representative's review, distribute copies.
  - .3 Submit electronic copy of shop drawings for each requirement requested in specification Sections and as Representative may reasonably request.
  - .4 Submit electronic copies of product data sheets or brochures for requirements requested in specification Sections and as requested by Representative where shop drawings will not be prepared due to standardized manufacture of product.
  - .5 Submit electronic copies of certificates for requirements requested in specification Sections and as requested by Representative.
    - .1 Statements printed on manufacturer's letterhead and signed by responsible officials of manufacturer of product, system or material attesting that product, system or material meets specification requirements.
    - .2 Certificates must be dated after award of project contract complete with project name.
  - .6 Submit electronic copies of manufacturer's instructions for requirements requested in specification Sections and as requested by Representative.
    - .1 Pre-printed material describing installation of product, system or material, including special notices and Material Safety Data Sheets concerning impedances, hazards and safety precautions.
  - .7 Submit electronic copies of Manufacturer's Field Reports for requirements requested in specification Sections and as requested by Representative.
  - .8 Documentation of the testing and verification actions taken by manufacturer's representative to confirm compliance with manufacturer's standards or instructions.
  - .9 Submit electronic copies of Operation and Maintenance Data for requirements requested in specification Sections and as requested by Representative.
  - .10 Delete information not applicable to project.
  - .11 Supplement standard information to provide details applicable to project.
  - .12 If upon review by Representative, no errors or omissions are discovered or if only minor corrections are made, transparency copies will be returned and fabrication and installation of Work may proceed. If shop drawings are rejected, noted copy will be returned and resubmission of corrected shop drawings, through same procedure indicated above, must be performed before fabrication and installation of Work may proceed.



**1.4 CMMS Data Sheets**

1. Immediately after the approval of the shop drawings, preparation of CMMS documents shall begin. Once the equipment is installed on site, all CMMS Data Sheets must be completed.
2. Submit CMMS Data Sheets for all equipment/system(s) being removed/decommissioned to Project Manager prior their removal.
3. Completed CMMS Data Sheets are to include all required information.
4. Submit CMMS Data Sheet to the Project Manager for distribution to the Consultant and 3rd party Cx agent (if applicable) review.
5. All CMMS documents must be turned over to the Project Manager for new, modified and or relocated, prior to equipment start up.
6. Consultant to review and confirm completeness of the information provided. Consultant will submit CMMS Data Sheets to the Project Manager no later than 5 business days from receipt of CMMS submission.
7. CMMS Data Sheet document (PDF) included in Annex at the end of this section.
8. At the start-up construction meeting, support the Project Manager in providing instructions to the contractor concerning the data required to be included on the CMMS form and required date/timing of CMMS Data Sheets submission.
9. After the Construction Start-up meeting, the Commissioning Oversight Representative will provide an Electronic copy (Excel version) of the CMMS form to the contractor with known information in Section A completed (i.e. Building Name, Number and Address and Project Number).

**1.5 SAMPLES**

NOT USED

**1.6 PHOTOGRAPHIC DOCUMENTATION**

- .1 Submit electronic and hard copy of colour digital photography in jpg format, standard resolution and as directed by Representative.
- .2 Project identification: name and number of project and date of exposure indicated.
- .3 Number of viewpoints: 2 locations.
  - .1 Viewpoints and their location as determined by Representative.
- .4 Frequency of photographic documentation: as directed by Representative.
  - .1 Upon completion of Work, and as directed by Representative.

**1.7 CERTIFICATES AND TRANSCRIPTS**

- .1 Immediately after award of Contract, submit Workers' Compensation Board status.
- .2 Submit transcription of insurance immediately after award of Contract.

**Part 2 - Products**

**2.1 NOT USED**

- .1 Not Used.

**Part 3 - Execution**

**3.1 NOT USED**

- .1 Not Used.

**-- END OF SECTION --**

**Part 1 - General****1.1 FIRES**

- .1 Fires and burning of rubbish on site is not permitted.

**1.2 DISPOSAL OF WASTES**

- .1 Do not dispose of waste, chemicals, volatile materials, oils or paint thinner into waterways, storm or sanitary sewers.
- .2 A Waste Audit (WA) is to be submitted to the Representative within seven (7) days of project award.
  - .1 Waste Audit (WA): A detailed inventory of liquid waste, waste waters, solid wastes, hazardous wastes, and construction and demolition wastes that will be generated during project activities. The WA details quantities of materials destined for reuse, recycling, and disposal, and the proposed destinations for these materials. Refer to Waste Audit Template following this section.
  - .2 The WA will quantify by volume or weight estimates, the quantities of materials, liquid wastes, solid wastes, and construction and demolition wastes that are expected to be generated during project activities.
  - .3 The WA will be updated on a weekly basis and submitted to the Representative for review. The WA updates will quantify the actual volume/weight quantities for the amounts of materials, liquid wastes, solid wastes, and construction and demolition wastes generated during project activities.
- .3 Solid waste will be managed and disposed of following applicable federal, provincial, and municipal regulations.
- .4 Dispose of non-regulated construction and demolition (C&D) materials which cannot be recycled or reused at a C&D disposal site licensed to receive C&D waste.
- .5 Dispose of hazardous materials, hazardous wastes, and regulated waste at disposal sites licensed by the governing municipal or provincial authorities to receive the specific hazardous materials or regulated wastes.

**1.3 POLLUTION CONTROL**

- .1 Control emissions from equipment and plant to local authorities' emission requirements.
- .2 For all works being completed within the confines of a building, contractors will design a work plan and utilize equipment that will not impact air quality within the building.

**1.4 DUST AND DUST CONTROL**

- .1 Dust and debris with potential to be disturbed or generated by contract activities must be contained to the immediate work area to ensure adjacent areas and occupants are not impacted by dust.
  - .1 Utilize work procedures, engineered controls, and mitigating measures to control dust releases that are appropriate for the contract activities and site conditions.
  - .2 Dust and debris will be cleaned up at the end of each workday.

- .3 If dust that is disturbed or generated by contract activities migrates from the contract work area, the Contractor will stop contract activities and mitigate the migration of dust.
  - .1 The Contractor is responsible for the cleaning of all dust and debris disturbed/generated by contract activities.

## **1.5 ENVIRONMENTAL INCIDENT AND RESPONSE**

- .1 All spills and leaks, such as those from machinery or fuel storage tanks, must be promptly contained, cleaned up and reported immediately to the Representative.
- .2 To ensure a quick and effective response to a spill event, the Contractor must ensure spill response equipment will be readily available on site for any hazardous materials used in the completion of the work (e.g. fuels, oils, lubricants, etc.).
  - .1 Personnel working on the project must be knowledgeable about the response procedure and trained in the use of spill response equipment.
- .3 Refueling and maintenance of equipment must only occur at areas designated by the Representative.

## **1.6 ENCOUNTERING UNIDENTIFIED SITE CONDITIONS**

- .1 If suspected hazardous materials, hazardous wastes, or designated substances are discovered that were not previously identified in the contract documents, the contractor will:
  - .1 Stop work activities that have potential to disturb the suspect material;
  - .2 Notify the Representative immediately;
  - .3 Identify suspected hazardous materials, hazardous waste, or designated substances to the Representative and accommodate for third party testing of the suspect materials;
  - .4 The contractor will discuss a way-forward with the Representative.

## **1.7 ENVIRONMENTAL PROTECTION PLAN**

- .1 Definitions
  - .1 Environmental Pollution and Damage: presence of chemical, physical, biological elements or agents which adversely affect human health and welfare; unfavourably alter ecological balances of importance to human life; affect other species of importance to humankind; or degrade environment aesthetically, culturally and/or historically.
  - .2 Environmental Protection: prevention/control of pollution and habitat or environment disruption during project activities. Control of environmental pollution and damage requires consideration of land, water, and air; biological and cultural resources; and includes management of visual aesthetics; noise; solid, chemical, gaseous, and liquid waste; radiant energy and radioactive material as well as other pollutants.
- .2 Contractor will develop an Environmental Protection/Spill Response Plan appropriate to the level/type of work being conducted.
  - .1 The Environmental Protection/Spill Response Plan must:
    - .1 Identify contract activities that have potential to contribute to Environmental Pollution or Damage and

- .2 Provide mitigative measures, contingency plans, and emergency procedures that will be implemented during the project to prevent and control Environmental Pollution or Damage.
- .2 The Environmental Protection/Spill Response Plan will identify a Contractor representative responsible for the implementation of the Plan.
- .3 The Environmental Protection /Spill Response Plan will be forwarded to the Representative for review within 7 days of contract award.
- .4 Representative will notify Contractor in writing of observed non-compliance with Federal, Provincial or Municipal environmental laws or regulations, permits, and other elements of Contractor's Environmental Protection /Spill Response Plan.
  - .1 After Contractor's receipt of such notice, inform Representative of proposed corrective action and take such action for approval by the Representative.
  - .2 Representative will issue stop order of work until satisfactory corrective action has been taken.
  - .3 No time extensions granted or equitable adjustments allowed to Contractor for such suspensions.

**-- END OF SECTION --**

**Part 1 - General****1.1 REFERENCES**

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

**1.2 INSPECTION**

- .1 Refer to CCDC 2, GC 2.3.
- .2 Allow Representative access to Work. If part of Work is in preparation at locations other than Place of Work, allow access to such Work whenever it is in progress.
- .3 Give timely notice requesting inspection if Work is designated for special tests, inspections or approvals by Representative instructions, or law of Place of Work.
- .4 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.
- .5 Representative will order part of Work to be examined if Work is suspected to be not in accordance with Contract Documents.

**1.3 INDEPENDENT INSPECTION AGENCIES**

- .1 Independent Inspection/Testing Agencies will be engaged by Representative for purpose of inspecting and/or testing portions of Work. Cost of such services will be borne by Representative.
- .2 Provide equipment required for executing inspection and testing by appointed agencies.
- .3 Employment of inspection/testing agencies does not 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 Representative at no cost to the Representative. Pay costs for retesting and reinspection.
- .5 The contractor is advised that the Independent Inspection/Testing Agencies that will be engaged by Representative for purpose of inspecting and/or testing portions of work is in addition to the contractor's requirement for inspection, testing, commissioning and certifications for the systems as outlined in the specifications and drawings.

**1.4 ACCESS TO WORK**

- .1 Allow inspection/testing agencies access to Work, off site manufacturing and fabrication plants.

- .2 Co-operate to provide reasonable facilities for such access.

## **1.5 PROCEDURES**

- .1 Notify appropriate agency and Representative in advance of requirement for tests, in order that attendance arrangements can be made.
- .2 Submit samples and/or materials required for testing, as specifically requested in specifications. Submit with reasonable promptness and in orderly sequence to not cause delays in Work.
- .3 Provide labour and facilities to obtain and handle samples and materials on site. Provide sufficient space to store and cure test samples.

## **1.6 REJECTED WORK**

- .1 Refer to CCDC, GC 2.4.
- .2 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 as failing to conform to Contract Documents. Replace or re-execute in accordance with Contract Documents.
- .3 Make good other Contractor's work damaged by such removals or replacements promptly.
- .4 If in opinion of Representative it is not expedient to correct defective Work or Work not performed in accordance with Contract Documents, Owner will deduct from Contract Price difference in value between Work performed and that called for by Contract Documents, amount of which will be determined by Representative.

## **1.7 REPORTS**

- .1 Submit 4 copies of inspection and test reports to Representative.
- .2 Provide copies to manufacturer or fabricator of material being inspected or tested.

## **1.8 TESTS AND MIX DESIGNS**

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

## **1.9 MILL TESTS**

- .1 Submit mill test certificates as requested.

**Part 2 - Products**

**2.1 NOT USED**

.1 Not Used.

**Part 3 - Execution**

**3.1 NOT USED**

.1 Not Used.

**-- END OF SECTION --**



**Part 1 - General****1.1 REFERENCES**

- .1 Canadian Construction Documents Committee (CCDC)
  - .1 CCDC 2-94, Stipulated Price Contract.
- .2 Within text of each specifications section, reference may be made to reference standards.
- .3 Conform to these reference standards, in whole or in part as specifically requested in specifications.
- .4 If there is question as to whether products or systems are in conformance with applicable standards, Representative reserves right to have such products or systems tested to prove or disprove conformance.
- .5 Cost for such testing will be borne by Representative in event of conformance with Contract Documents or by Contractor in event of non-conformance.

**1.2 QUALITY**

- .1 Refer to CCDC 2-94.
- .2 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.
- .3 Procurement policy is to acquire, in cost effective manner, items containing highest percentage of recycled and recovered materials practicable consistent with maintaining satisfactory levels of competition. Make reasonable efforts to use recycled and recovered materials and in otherwise utilizing recycled and recovered materials in execution of work.
- .4 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.
- .5 Should disputes arise as to quality or fitness of products, decision rests strictly with the Representative based upon requirements of Contract Documents.
- .6 Unless otherwise indicated in specifications, maintain uniformity of manufacture for any particular or like item throughout building.
- .7 Permanent labels, trademarks and nameplates on products are not acceptable in prominent locations, except where required for operating instructions, or when located in mechanical or electrical rooms.

**1.3 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 Representative of such, in order that substitutions or other remedial action may be authorized in ample time to prevent delay in performance of Work.
- .2 In event of failure to notify Representative at commencement of Work and should it subsequently appear that Work may be delayed for such reason, Representative reserves right to substitute more readily available products of similar character, at no increase in Contract Price or Contract Time.

**1.4 STORAGE, HANDLING AND PROTECTION**

- .1 Handle and store products in manner to prevent damage, adulteration, deterioration and soiling and in accordance with manufacturer's instructions when applicable.
- .2 Store packaged or bundled products in original and undamaged condition with manufacturer's seal and labels intact. Do not remove from packaging or bundling until required in Work.
- .3 Store products subject to damage from weather in weatherproof enclosures.
- .4 Store cementitious products clear of earth or concrete floors, and away from walls.
- .5 Keep sand, when used for grout or mortar materials, clean and dry. Store sand on wooden platforms and cover with waterproof tarpaulins during inclement weather.
- .6 Store sheet materials, lumber and structural steel 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 Representative.
- .9 Touch-up damaged factory finished surfaces to Representative's satisfaction. Use touch-up materials to match original. Do not paint over name plates.

**1.5 TRANSPORTATION**

- .1 Pay costs of transportation of products required in performance of Work.
- .2 Transportation cost of products supplied by Owner will be paid for by Representative. Unload, handle and store such products.

**1.6 MANUFACTURER'S INSTRUCTIONS**

- .1 Unless otherwise indicated in specifications, install or erect products in accordance with manufacturer's instructions. Do not rely on labels or enclosures provided with products. Obtain written instructions directly from manufacturers.

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

## **1.7 QUALITY OF WORK**

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

## **1.8 CO-ORDINATION**

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

## **1.9 REMEDIAL WORK**

- .1 Refer to CCDC 2 and Section 01 73 00 - Execution Requirements.
- .2 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.
- .3 Perform remedial work by specialists familiar with materials affected. Perform in a manner to neither damage nor put at risk any portion of Work.

## **1.10 LOCATION OF FIXTURES**

- .1 Consider location of fixtures, outlets, and mechanical and electrical items indicated as approximate.
- .2 Inform Representative of conflicting installation. Install as directed.

## **1.11 FASTENINGS**

- .1 Provide metal fastenings and accessories in same texture, colour and finish as adjacent materials, unless indicated otherwise.
- .2 Prevent electrolytic action between dissimilar metals and materials.

- .3 Use non-corrosive hot dip galvanized steel fasteners and anchors for securing exterior work, unless stainless steel or other material is specifically requested in affected specification Section.
- .4 Space anchors within individual load limit or shear capacity and ensure they provide positive permanent anchorage. Wood, or any other organic material plugs are not acceptable.
- .5 Keep exposed fastenings to a minimum, space evenly and install neatly.
- .6 Fastenings which cause spalling or cracking of material to which anchorage is made are not acceptable.

### **1.12 FASTENINGS - EQUIPMENT**

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

### **1.13 PROTECTION OF WORK IN PROGRESS**

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

## **Part 2 - Products**

### **2.1 NOT USED**

- .1 Not Used.

## **Part 3 - Execution**

### **3.1 NOT USED**

- .1 Not Used.

**-- END OF SECTION --**

**Part 1 - General****1.1 RELATED REQUIREMENTS****1.2 REFERENCES**

- .1 Canadian Construction Documents Committee (CCDC)
  - .1 CCDC 2-2008, Stipulated Price Contract.

**1.3 ADMINISTRATIVE REQUIREMENTS**

- .1 Acceptance of Work Procedures:
  - .1 Contractor's Inspection: Contractor: conduct inspection of Work, identify deficiencies and defects, and repair as required to conform to Contract Documents.
    - .1 Notify Representative in writing of satisfactory completion of inspection and submit verification that corrections have been made.
    - .2 Request Representative and Engineer's inspection.
  - .2 Representative and Engineer's Inspection:
    - .1 Representative and Engineer and Contractor to inspect Work and identify defects and deficiencies.
    - .2 Contractor to correct Work as directed.
  - .3 Completion Tasks: submit written certificates in English that tasks have been performed as follows:
    - .1 Work: completed and inspected for compliance with Contract Documents.
    - .2 Defects: corrected and deficiencies completed.
    - .3 Equipment and systems: tested, adjusted and fully operational.
    - .4 Operation of systems: demonstrated to Owner's personnel.
    - .5 Work: complete and ready for final inspection.
  - .4 Final Inspection:
    - .1 When completion tasks are done, request final inspection of Work by the Representative, Engineer and Contractor
    - .2 When Work incomplete according to Representative and Engineer, complete outstanding items and request re-inspection.
  - .5 Payment of Holdback: after issuance of Certificate of Substantial Performance of Work, submit application for payment of holdback amount in accordance with contractual agreement.

-- END OF SECTION --

**Part 1 - General****1.1 RELATED REQUIREMENTS**

- .1 Section 01 11 00 – Summary of Work

**1.2 ADMINISTRATIVE REQUIREMENTS**

- .1 Pre-warranty Meeting:
  - .1 Convene meeting one week prior to contract completion with contractor's representative, and Consultant Representative to:
    - .1 Verify Project requirements.
    - .2 Review manufacturer's installation instructions and warranty requirements.
  - .2 Contractor's Representative to establish communication procedures for:
    - .1 Notifying construction warranty defects.
    - .2 Determine priorities for type of defects.
    - .3 Determine reasonable response time.
  - .3 Contact information for bonded and licensed company for warranty work action: provide name, telephone number and address of company authorized for construction warranty work action.
  - .4 Ensure contact is located within local service area of warranted construction, is continuously available, and is responsive to inquiries for warranty work action.

**1.3 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Two weeks prior to Substantial Performance of the Work a preliminary OM manual to be provided to the Representative. On approval a final copy of operating and maintenance manuals in English.
- .3 Provide spare parts, maintenance materials and special tools of same quality and manufacture as products provided in Work.
- .4 Provide evidence, if requested, for type, source and quality of products supplied.

**1.4 FORMAT**

- .1 Refer to Appendix A – O&M Manual Guidelines.

**1.5 CONTENTS - PROJECT RECORD DOCUMENTS**

- .1 Table of Contents for Each Volume: provide title of project;
  - .1 Date of submission; names.
  - .2 Addresses, and telephone numbers of Consultant and Contractor with name of responsible parties.
  - .3 Schedule of products and systems, indexed to content of volume.
- .2 For each product or system:

- .1 List names, addresses and telephone numbers of subcontractors and suppliers, including local source of supplies and replacement parts.
- .3 Product Data: mark each sheet to identify specific products and component parts, and data applicable to installation; delete inapplicable information.
- .4 Drawings: supplement product data to illustrate relations of component parts of equipment and systems, to show control and flow diagrams.
- .5 Typewritten Text: as required to supplement product data.
  - .1 Provide logical sequence of instructions for each procedure, incorporating manufacturer's instructions specified in Section 01 45 00 - Quality Control.

## **1.6 AS -BUILT DOCUMENTS AND SAMPLES**

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

## **1.7 RECORDING INFORMATION ON PROJECT RECORD DOCUMENTS**

- .1 Record information on set of black line opaque drawings, and in copy of Project Manual, provided by Contractor.
- .2 CMMS form to be filled, it is provided in the appendix. Asset inventory number of any equipment removed must also be noted on CMMS sheet so that inventory can be properly adjusted.
- .3 Use felt tip marking pens, maintaining separate colours for each major system, for recording information.

- .4 Record information concurrently with construction progress.
  - .1 Do not conceal Work until required information is recorded.
- .5 Contract Drawings and shop drawings: mark each item to record actual construction, including:
  - .1 Field changes of dimension and detail.
  - .2 Changes made by change orders.
  - .3 Details not on original Contract Drawings.
  - .4 References to related shop drawings and modifications.
- .6 Specifications: mark each item to record actual construction, including:
  - .1 Manufacturer, trade name, and catalogue number of each product actually installed, particularly optional items and substitute items.
  - .2 Changes made by Addenda and change orders.
- .7 Other Documents: maintain manufacturer's certifications and inspection certifications required by individual specifications sections.
- .8 Provide digital photos, if requested, for site records.

## **1.8 FINAL SURVEY**

- .1 Submit final site survey certificate in accordance with Section 01 71 00 - Examination and Preparation, certifying that elevations and locations of completed Work are in conformance, or non-conformance with Contract Documents.

## **1.9 MAINTENANCE MATERIALS**

- .1 Spare Parts:
  - .1 Provide spare parts, in quantities specified in individual specification sections.
  - .2 Provide items of same manufacture and quality as items in Work.
  - .3 Deliver to site location as directed; place and store.
  - .4 Receive and catalogue items.
    - .1 Submit inventory listing to Representative.
    - .2 Include approved listings in Maintenance Manual.
  - .5 Obtain receipt for delivered products and submit prior to final payment.
- .2 Extra Stock Materials:
  - .1 Provide maintenance and extra materials, in quantities specified in individual specification sections.
  - .2 Provide items of same manufacture and quality as items in Work.
  - .3 Deliver to site location as directed; place and store.
  - .4 Receive and catalogue items.
    - .1 Submit inventory listing to Representative.
    - .2 Include approved listings in Maintenance Manual.
  - .5 Obtain receipt for delivered products and submit prior to final payment.
- .3 Special Tools:



- .1 Provide special tools, in quantities specified in individual specification section.
- .2 Provide items with tags identifying their associated function and equipment.
- .3 Deliver to site; place and store.
- .4 Receive and catalogue items.
  - .1 Submit inventory listing to Representative.
  - .2 Include approved listings in Maintenance Manual.

#### **1.10 DELIVERY, STORAGE AND HANDLING**

- .1 Store spare parts, maintenance materials, and special tools in manner to prevent damage or deterioration.
- .2 Store in original and undamaged condition with manufacturer's seal and labels intact.
- .3 Store components subject to damage from weather in weatherproof enclosures.
- .4 Store paints and freezable materials in a heated and ventilated room.
- .5 Remove and replace damaged products at own expense and for review by Representative.

#### **1.11 WARRANTIES AND BONDS**

- .1 Develop warranty management plan to contain information relevant to Warranties. Project shall include a 1 year workmanship warranty from the general contractor from the date of issuance of the substantial completion certificate from the consultant.
- .2 Submit warranty management plan, 30 days before planned pre-warranty conference, to Representative for approval.
- .3 Warranty management plan to include required actions and documents to assure that Representative receives warranties to which it is entitled.
- .4 Provide plan in narrative form and contain sufficient detail to make it suitable for use by future maintenance and repair personnel.
- .5 Submit, warranty information made available during construction phase, to Representative for approval prior to each monthly pay estimate.
- .6 Assemble approved information in binder, submit upon acceptance of work and organize binder as follows:
  - .1 Separate each warranty or bond with index tab sheets keyed to Table of Contents listing.
  - .2 List subcontractor, supplier, and manufacturer, with name, address, and telephone number of responsible principal.
  - .3 Obtain warranties and bonds, executed in duplicate by subcontractors, suppliers, and manufacturers, within ten (10) days after completion of applicable item of work.
  - .4 Verify that documents are in proper form, contain full information, and are notarized.
  - .5 Co-execute submittals when required.

- .6 Retain warranties and bonds until time specified for submittal.
- .7 Except for items put into use with Owner's permission, leave date of beginning of time of warranty until Date of Substantial Performance is determined.
- .8 Conduct joint warranty inspection at the 11 month period measured from the date of substantial completion, by Representative.
- .9 Include information contained in warranty management plan as follows:
  - .1 Roles and responsibilities of personnel associated with warranty process, including points of contact and telephone numbers within the organizations of Contractors, subcontractors, manufacturers or suppliers involved.
  - .2 Provide list for each warranted equipment, item, feature of construction or system indicating:
    - .1 Name of item.
    - .2 Model and serial numbers.
    - .3 Location where installed.
    - .4 Name and phone numbers of manufacturers or suppliers.
    - .5 Names, addresses and telephone numbers of sources of spare parts.
    - .6 Warranties and terms of warranty: include one-year overall warranty of construction. Indicate items that have extended warranties and show separate warranty expiration dates.
    - .7 Cross-reference to warranty certificates as applicable.
    - .8 Starting point and duration of warranty period.
    - .9 Summary of maintenance procedures required to continue warranty in force.
    - .10 Cross-Reference to specific pertinent Operation and Maintenance manuals.
    - .11 Organization, names and phone numbers of persons to call for warranty service.
    - .12 Typical response time and repair time expected for various warranted equipment.
  - .3 Contractor's plans for attendance at 6 and 12 month post-construction warranty inspections.
  - .4 Procedure and status of tagging of equipment covered by extended warranties.
  - .5 Post copies of instructions near selected pieces of equipment where operation is critical for warranty and/or safety reasons.
- .10 Respond in timely manner to oral or written notification of required construction warranty repair work.
- .11 Written verification to follow oral instructions.
  - .1 Failure to respond will be cause for the Representative to proceed with action against Contractor.

## **1.12 WARRANTY TAGS**

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

- .2 Attach tags with copper wire and spray with waterproof silicone coating.
- .3 Leave date of acceptance until project is accepted for occupancy.
- .4 Indicate following information on tag:
  - .1 Type of product/material.
  - .2 Model number.
  - .3 Serial number.
  - .4 Contract number.
  - .5 Warranty period.
  - .6 Inspector's signature.
  - .7 Construction Contractor.

**Part 2 - Products**

**2.1 NOT USED**

- .1 Not Used.

**Part 3 - Execution**

**3.1 NOT USED**

- .1 Not Used.

**-- END OF SECTION --**

**Part 1 - General****1.1 RELATED REQUIREMENTS****1.2 ADMINISTRATIVE REQUIREMENTS**

- .1 Demonstrate operation and maintenance of equipment and systems to Owner's personnel two weeks prior to date of final inspection.
- .2 Owner: provide list of personnel to receive instructions, and co-ordinate their attendance at agreed-upon times.
- .3 Preparation:
  - .1 Verify conditions for demonstration and instructions comply with requirements.
  - .2 Verify designated personnel are present.
  - .3 Ensure testing, adjusting, and balancing has been performed in accordance with Section 01 91 13 - General Commissioning (Cx) Requirements and equipment and systems are fully operational.
- .4 Demonstration and Instructions:
  - .1 Demonstrate start-up, operation, control, adjustment, trouble-shooting, servicing, and maintenance of each item of equipment at agreed upon times, at the equipment location.
  - .2 Instruct personnel in phases of operation and maintenance using operation and maintenance manuals as basis of instruction.
  - .3 Review contents of manual in detail to explain aspects of operation and maintenance.
  - .4 Prepare and insert additional data in operations and maintenance manuals when needed during instructions.

**1.3 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Submit schedule of time and date for demonstration of each item of equipment and each system two weeks prior to designated dates, for Departmental Representative's and Consultant's approval.
- .3 Submit reports within one week after completion of demonstration, that demonstration and instructions have been satisfactorily completed.
- .4 Give time and date of each demonstration, with list of persons present.
- .5 Provide copies of completed operation and maintenance manuals for use in demonstrations and instructions.

**1.4 QUALITY ASSURANCE**

- .1 When specified in individual Sections requiring manufacturer to provide authorized representative to demonstrate operation of equipment and systems:

- .1 Instruct Owner's personnel.
- .2 Provide written report that demonstration and instructions have been completed.

**Part 2 – Products**

**2.1 NOT USED**

- .1 Not Used.

**Part 3 – Execution**

**3.1 NOT USED**

- .1 Not Used.

**-- END OF SECTION --**

**Part 1 - General****1.1 SUMMARY**

- .1 Section Includes:
  - .1 General requirements relating to commissioning of project's components and systems, specifying general requirements to PV of components, equipment, sub-systems, systems, and integrated systems.
  - .2 Project components and systems include generator, Automatic transfer switch, annunciator, panel and breakers. All associated wiring and accessories are to be installed for a complete working standby power system.
- .2 Related Sections: 01 11 00 – Summary of Work
- .3 Acronyms:
  - .1 AFD - Alternate Forms of Delivery, service provider.
  - .2 BMM - Building Management Manual.
  - .3 Cx - Commissioning.
  - .4 EMCS - Energy Monitoring and Control Systems.
  - .5 O&M - Operation and Maintenance.
  - .6 PI - Product Information.
  - .7 PV - Performance Verification.
  - .8 TAB - Testing, Adjusting and Balancing.

**1.2 GENERAL**

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

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

### **1.3 COMMISSIONING OVERVIEW**

- .1 For Cx responsibilities refer to Section 01 91 13 – General Commissioning (Cx) Requirements.
- .2 Cx activities supplement field quality and testing procedures described in relevant technical sections.
- .3 Cx is conducted in concert with activities performed during stage of project delivery. Cx identifies issues in Planning and Design stages which are addressed during Construction and Cx stages to ensure the built facility is constructed and proven to operate satisfactorily under weather, environmental and occupancy conditions to meet functional and operational requirements. Cx activities includes transfer of critical knowledge to facility operational personnel.
- .4 Departmental Representative will issue Interim Acceptance Certificate when:
  - .1 Completed Cx documentation has been received, reviewed for suitability and approved by Departmental Representative.
  - .2 Equipment, components and systems have been commissioned.
  - .3 O&M training has been completed.

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

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

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

- .1 Before Construction:
  - .1 Review contract documents, confirm by writing to Departmental Representative.
    - .1 Adequacy of provisions for Cx.
    - .2 Aspects of design and installation pertinent to success of Cx.
- .2 During Construction:
  - .1 Co-ordinate provision, location and installation of provisions for Cx.
- .3 Before start of Cx:
  - .1 Have completed Cx Plan up-to-date.
  - .2 Ensure installation of related components, equipment, sub-systems, systems is complete.

- .3 Fully understand Cx requirements and procedures.
  - .4 Have Cx documentation shelf-ready.
  - .5 Understand completely design criteria and intent and special features.
  - .6 Submit complete start-up documentation to Departmental Representative.
  - .7 Have Cx schedules up-to-date.
  - .8 Ensure systems have been cleaned thoroughly.
  - .9 Complete TAB procedures on systems, submit TAB reports to Departmental Representative for review and approval.
  - .10 Ensure "As-Built" system schematics are available.
- .4 Inform Departmental Representative in writing of discrepancies and deficiencies on finished works.

## **1.6 CONFLICTS**

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

## **1.7 SUBMITTALS**

- .1 Submittals: in accordance with Section 01 33 00 - Submittal Procedures.
  - .1 Submit no later than 4 weeks after award of Contract:
    - .1 Name of Contractor's Cx agent.
    - .2 Draft Cx documentation.
    - .3 Preliminary Cx schedule.
  - .2 Request in writing to Departmental Representative for changes to submittals and obtain written approval at least 8 weeks prior to start of Cx.
  - .3 Submit proposed Cx procedures to Departmental Representative where not specified and obtain written approval at least 8 weeks prior to start of Cx.
  - .4 Provide additional documentation relating to Cx process required by Departmental Representative.

## **1.8 COMMISSIONING DOCUMENTATION**

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

## **1.9 COMMISSIONING SCHEDULE**

- .1 Testing and training shall be completed before the project is substantially complete.



- .2 Provide adequate time for Cx activities prescribed in technical sections and commissioning sections including:
  - .1 Schedule a commissioning meeting with stakeholders prior to going to site for commissioning with Cx Agent (Consultant). Meeting minutes to be taken and circulated.
  - .2 Approval of Cx reports.
  - .3 Verification of reported results.
  - .4 Repairs, retesting, re-commissioning, re-verification.
  - .5 Training.

### **1.10 COMMISSIONING MEETINGS**

- .1 Purpose: to resolve issues, monitor progress, identify deficiencies, relating to Cx.
- .2 Continue Cx meetings on regular basis until commissioning deliverables have been addressed.
- .3 At 60% construction completion stage. Departmental Representative to call a separate Cx scope meeting to review progress, discuss schedule of equipment start-up activities and prepare for Cx. Issues at meeting to include:
  - .1 Review duties and responsibilities of Contractor and subcontractors, addressing delays and potential problems.
  - .2 Determine the degree of involvement of trades and manufacturer's representatives in the commissioning process.
- .4 Thereafter Cx meetings to be held until project completion and as required during equipment start-up and functional testing period.
- .5 Meeting will be chaired by Departmental Representative, who will record and distribute minutes.
- .6 Ensure subcontractors and relevant manufacturer representatives are present at 60% and subsequent Cx meetings and as required.

### **1.11 STARTING AND TESTING**

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

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

- .1 Provide 14 days notice prior to commencement.
- .2 Departmental Representative to witness of start-up and testing.
- .3 The consultant (Cx Agent) shall witness start-up and testing. Department Rep to be made aware of such tests and be given the same notice in order to make themselves available.
- .4 Contractor's Cx Agent to be present at tests performed and documented by sub-trades, suppliers and equipment manufacturers.

**1.13 MANUFACTURER'S INVOLVEMENT**

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

**1.14 PROCEDURES**

- .1 Verify that equipment and systems are complete, clean, and operating in normal and safe manner prior to conducting start-up, testing and Cx.
- .2 Conduct start-up and testing in following distinct phases:
  - .1 Included in delivery and installation:
    - .1 Verification of conformity to specification, approved shop drawings and completion of PI report forms.
    - .2 Visual inspection of quality of installation.
  - .2 Start-up: follow accepted start-up procedures.
  - .3 Operational testing: document equipment performance.
  - .4 System PV: include repetition of tests after correcting deficiencies.
  - .5 Post-substantial performance verification: to include fine-tuning.
  - .6 Test forms are included in Appendix
- .3 Correct deficiencies and obtain approval from Departmental Representative after distinct phases have been completed and before commencing next phase.
- .4 Document require tests on approved PV forms.
- .5 Failure to follow accepted start-up procedures will result in re-evaluation of equipment by an independent testing agency selected by Departmental Representative. If results

reveal that equipment start-up was not in accordance with requirements, and resulted in damage to equipment, implement following:

- .1 Minor equipment/systems: implement corrective measures approved by Departmental Representative.
- .2 Major equipment/systems: if evaluation report concludes that damage is minor, implement corrective measures approved by Departmental Representative.
- .3 If evaluation report concludes that major damage has occurred, Departmental Representative shall reject equipment.
  - .1 Rejected equipment to be remove from site and replace with new.
  - .2 Subject new equipment/systems to specified start-up procedures.

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

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

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

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

#### **1.17 TEST RESULTS**

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

#### **1.18 START OF COMMISSIONING**

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

**1.19 INSTRUMENTS / EQUIPMENT**

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

**1.20 COMMISSIONING PERFORMANCE VERIFICATION**

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

**1.21 WITNESSING COMMISSIONING**

- .1 The consultant (Cx Agent) shall witness start-up and testing. Department Rep to be made aware of such tests and be given the same notice in order to make themselves available.

**1.22 AUTHORITIES HAVING JURISDICTION**

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

**1.23 COMMISSIONING CONSTRAINTS**

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

**1.24 EXTRAPOLATION OF RESULTS**

- .1 Where Cx of weather, occupancy, or seasonal-sensitive equipment or systems cannot be conducted under near-rated or near-design conditions, extrapolate part-load results to

design conditions when approved by Departmental Representative in accordance with equipment manufacturer's instructions, using manufacturer's data, with manufacturer's assistance and using approved formulae.

### **1.25 EXTENT OF VERIFICATION**

- .1 Laboratory areas:
  - .1 Provide manpower and instrumentation to verify up to 100% of reported results.
- .2 Elsewhere:
  - .1 Provide manpower and instrumentation to verify up to 30% of reported results, unless specified otherwise in other sections.
- .3 Number and location to be at discretion of Departmental Representative.
- .4 Conduct tests repeated during verification under same conditions as original tests, using same test equipment, instrumentation.
- .5 Review and repeat commissioning of systems if inconsistencies found in more than 20% of reported results.
- .6 Perform additional commissioning until results are acceptable to Departmental Representative.

### **1.26 REPEAT VERIFICATIONS**

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

### **1.27 SUNDRY CHECKS AND ADJUSTMENTS**

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

### **1.28 DEFICIENCIES, FAULTS, DEFECTS**

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

### **1.29 COMPLETION OF COMMISSIONING**

- .1 Upon completion of Cx leave systems in normal operating mode.

- .2 Except for warranty and seasonal verification activities specified in Cx specifications, complete Cx prior to issuance of Interim Certificate of Completion.
- .3 Cx to be considered complete when contract Cx deliverables have been submitted and accepted by Departmental Representative.

### **1.30 ACTIVITIES UPON COMPLETION OF COMMISSIONING**

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

### **1.31 TRAINING**

- .1 Section 01 79 00 – Demonstration and Training.

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

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

### **1.33 OCCUPANCY**

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

### **1.34 INSTALLED INSTRUMENTATION**

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

### **1.35 PERFORMANCE VERIFICATION TOLERANCES**

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

### **1.36 OWNER'S PERFORMANCE TESTING**

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

**Part 2 - Products**

**2.1**            **NOT USED**

.1        Not Used.

**Part 3 - Execution**

**3.1**            **NOT USED**

.1        Not Used.

**-- END OF SECTION --**

**Part 1      General****1.1          SUMMARY**

- .1      Section Includes:
  - .1          Commissioning forms to be completed for equipment, system and integrated system.
- .2      Related Requirements
  - .1          Section 01 11 00

**1.2          INSTALLATION/START-UP CHECK LISTS**

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

**1.3          PRODUCT INFORMATION (PI) REPORT FORMS**

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

**1.4          PERFORMANCE VERIFICATION (PV) FORMS**

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



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

## **1.5 SAMPLES OF COMMISSIONING FORMS**

- .1 Provide to Contractor required project-specific Commissioning forms in electronic format complete with specification data.
- .2 Revise items on Commissioning forms to suit project requirements.
- .3 Samples of Commissioning forms and a complete index of produced to date will be attached to this section.

## **1.6 CHANGES AND DEVELOPMENT OF NEW REPORT FORMS**

- .1 When additional forms are required, but are not available from [Departmental Representative develop appropriate verification forms and submit to Departmental Representative for approval prior to use.
  - .1 Additional commissioning forms to be in same format as provided by Departmental Representative.
  - .2 COMMISSIONING FORMS
- .2 Use Commissioning forms to verify installation and record performance when starting equipment and systems.
- .3 Strategy for Use:
  - .1 Departmental Representative provides Contractor project-specific Commissioning forms with Specification data included.
  - .2 Contractor will provide required shop drawings information and verify correct installation and operation of items indicated on these forms.
  - .3 Confirm operation as per design criteria and intent.
  - .4 Identify variances between design and operation and reasons for variances.
  - .5 Verify operation in specified normal and emergency modes and under specified load conditions.
  - .6 Record analytical and substantiating data.
  - .7 Verify reported results.
  - .8 Form to bear signatures of recording technician and reviewed and signed off by Consultant.
  - .9 Submit immediately after tests are performed.
  - .10 Reported results in true measured SI unit values.
  - .11 Provide Departmental Representative with originals of completed forms.
  - .12 Maintain copy on site during start-up, testing and commissioning period.
  - .13 Forms to be both hard copy and electronic format with typed written results in Building Management Manual.

**1.7 LANGUAGE**

- .1 To suit the language profile of the awarded contract.

**Part 2 Products**

**2.1 NOT USED**

- .1 Not Used.

**Part 3 Execution**

**3.1 NOT USED**

- .1 Not Used.

**END OF SECTION**

**Part 1 - General****1.1 RELATED WORK**

- .1 Section 03 20 00 – Concrete Reinforcement
- .2 Section 03 30 00.09 – Cast-In-Place Concrete – Short Form

**1.2 REFERENCES**

- .1 CSA-A23.1, Concrete Materials and Methods of Concrete Construction.
- .2 CSA-A23.2, Methods of Test and Standard Practices for Concrete.
- .3 CSA-A23.3, Design of Concrete Structures
- .4 CSA-O86, Engineering Design in Wood.
- .5 CSA O121, Douglas Fir Plywood.
- .6 CSA O151, Canadian Softwood Plywood.
- .7 CSA O153, Poplar Plywood.
- .8 CSA O437, CSA Standards for OSB and Waferboard.
- .9 CSA S269.1, Falsework for Construction Purposes.
- .10 CSA S269.2, Access Scaffolding for Construction Purposes
- .11 CSA-S269.3, Concrete Formwork.

**Part 2 - Products****2.1 MATERIALS**

- .1 For concrete without special architectural features, use wood and wood product formwork materials to CSA-O121, CSA-O86, CSA O437 Series and CSA-O153.
- .2 For concrete with special architectural features, use formwork materials to CSA-A23.1.
- .3 Form ties:
  - .1 For concrete not designated 'Architectural', use removable or snap-off metal ties, fixed or adjustable length, free of devices leaving holes larger than 25 mm diameter in concrete surface.
- .4 Form release agent:
  - .1 Chemically active, non-staining, release agents containing compounds that react with free lime in concrete resulting in water insoluble soaps. Non-toxic, biodegradable, low VOC.
- .5 Form stripping agent:
  - .1 Colourless, non-staining, mineral oil, non-toxic, biodegradable, low VOC, free of kerosene, with viscosity between 70 and 110 s, Saybolt Universal at 40 degrees C, and having a minimum flashpoint of 150 degrees C. Form release agents must be compatible with waterproofing systems where applicable.
- .6 Falsework materials: to CSA-S269.1.

**Part 3 - Execution****3.1 FABRICATION AND ERECTION**

- .1 Fabricate and erect formwork in accordance with CSA-S269.3 to produce finished concrete conforming to shape, dimensions, locations and levels indicated within tolerances required by CSA-A23.1.
- .2 Verify lines, levels and centres before proceeding with formwork/falsework and ensure dimensions agree with drawings.
- .3 Obtain Engineer's approval for use of earth forms and for framing openings not indicated on drawings.
- .4 Hand trim sides and bottoms and remove loose earth from earth forms before placing concrete.
- .5 Fabricate and erect falsework in accordance with CSA S269.1.
- .6 Do not place shores and mud sills on frozen ground.
- .7 Provide site drainage to prevent washout of soil supporting mud sills and shores.
- .8 Align form joints and make watertight. Keep form joints to minimum.
- .9 Locate horizontal form joints in exposed columns and walls 2400 mm above finished floor elevation.
- .10 Use 25 mm chamfer strips on exterior corners and 25 mm fillets at interior corners unless specified otherwise.
- .11 Form all chases, slots, openings, drips, recesses, expansion and control joints. Also form pockets in concrete walls for cladding anchorage as required.
- .12 Build in anchors, inserts, sleeves, miscellaneous frames, flashing reglets, weather bars, holes, and other inserts required to accommodate work of other sections. This includes all embedded items as required to support cladding elements and structural steel framing support. Assure that all anchors and inserts will not protrude beyond surfaces designated to receive applied finishes.
- .13 Clean formwork in accordance with CSA-A23.1, before placing concrete.
- .14 Construct forms for surfaces to receive membrane type waterproofing with taped joints and edges of plywood backed to prevent separation.
- .15 Construction Joints:
  - .1 Form construction joints where required and as approved by the structural Consultant.
  - .2 Costs of additional reinforcing steel resulting from splicing reinforcing bars, etc. as required to form construction joints in walls, slabs, etc. will be at the expense of the formwork contractor.
- .16 Waterstops:
  - .1 Build waterstops into forms. Support against displacement by pouring of concrete. Locate waterstops at construction joints in pits and trenches below floor levels, and as indicated on Drawings.
  - .2 Use preformed waterstop corners and intersections where they are available to suit conditions.

- .3 Join waterstops to preformed corners and intersections, and between lengths with butted and welded connections in accordance with manufacturer's recommendations.
- .17 Holes Cast into Concrete During Construction:
  - .1 Install all sleeves, ducts, pipes, and other openings.
  - .2 No sleeves, ducts, pipes or other openings shall pass through beams or column except where indicated or approved by Engineer.
  - .3 Ensure that where sleeves or pipes pass through slabs and walls they are fabricated of PVC, cast iron or galvanized steel. Sleeves shall not be spaced closer than three diameters on centre from adjacent sleeves unless approved by Engineer.
  - .4 Where approved by Engineer, set sleeves and openings as indicated or specified elsewhere. Provided they are shown on structural drawings, sleeves, pipes or openings, that are not greater than 450 mm square, or 450 mm in diameter, may pass through walls and slabs provided that no more than two reinforcing bars are interrupted and additional reinforcing steel is incorporated as per details on structural drawings. Contact structural Consultant before installing any openings greater than 150 mm x 150 mm or 150 mm diameter that are not shown on structural drawings.
  - .5 Check locations and sizes of sleeves and openings shown on drawings.

### 3.2 REMOVAL AND RESHORING

- .1 Leave formwork in place for following minimum periods of time after placing concrete:
  - .1 3 days for walls and sides of beams, columns and pedestals.
  - .2 28 days for beam soffits, slabs, decks and other structural members, or 7 days when replaced immediately with adequate shoring to standard specified for falsework.
  - .3 3 days for footings.
- .2 Formwork shall only be removed when concrete strength is 10 MPa minimum. Site cured cylinder will be required to determine strength of concrete.
- .3 Be responsible for the safety of the structure, both before and after removal of the forms, until concrete has reached its specified 28-day strength.
- .4 Take care in removing plywood forms. Do not jerk them loose or use metal pinch bars but use wood wedges and gradually force the panels loose. Leave plywood forms in place as long as possible and until other adjacent formwork is stripped to permit maximum shrinkage away from concrete and to protect surfaces. Take particular care to prevent damage to external corners of concrete.
- .5 Provide all necessary re-shoring of members where early removal of forms may be required or where members may be subjected to additional loads during construction as required.
- .6 Re-use formwork and falsework subject to requirements of CSA-A23.1.
- .7 Movement and displacement of formwork during construction, variations in excess of specified tolerances, and marked and disfigured surfaces that cannot be repaired by methods acceptable to Engineer will be considered defective Work performed by the Section.

- .8 Reconstruct defective formwork and replace concrete and reinforcement placed in defective formwork at no additional cost to the Owner.

### 3.3 **QUALITY OF FORMWORK**

- .1 Particular attention must be paid to the quality of all concrete exposed to view upon completion of the project including retaining walls. In exposed surfaces, form ties must be minimal, regular and neat and be plugged properly upon removal of formwork.
- .2 For the above-mentioned elements the following special precautions must be taken:
  - .1 All plywood form panels should be new at the start of this project.
  - .2 Concrete shall be smooth form finish as described in CSA A23.1
  - .3 Take special care in vibrating concrete in these elements.
  - .4 All joints in formwork, both horizontally and vertically must be aligned.
- .3 Any concrete falling short of these requirements shall be removed and replaced at the formwork contractor's expense.

-- END OF SECTION --

**Part 1 – General****1.1 RELATED WORK**

- .1 Section 03 10 00 – Concrete Formwork
- .2 Section 03 30 00.09 – Cast-In-Place Concrete – Short Form

**1.2 REFERENCES**

- .1 CSA-A23.1, Concrete Materials and Methods of Concrete Construction.
- .2 CSA-A23.2, Methods of Test and Standard Practices for Concrete.
- .3 CSA-A23.3, Design of Concrete Structures
- .4 CSA-G30.18, Billet-Steel Bars for Concrete Reinforcement.
- .5 CSA-G40.21, Structural Quality Steels.
- .6 CSA-G164, Hot Dip Galvanizing of Irregularly Shaped Articles
- .7 CSA W186, Welding of Reinforcing Bars in Reinforced Concrete Construction.
- .8 ASTM A-185, Standard Specification for Steel Welded Wire Reinforcement, Plain for Concrete
- .9 ASTM A-775, Standard Specification for Epoxy Coated Reinforcing Steel Bars
- .10 RSIC, Reinforcing Steel Manual of Standard Practice

**1.3 SHOP DRAWINGS**

- .1 Submit shop drawings including placing of reinforcement in accordance with Section 01 33 00.09 – Cast-in-Place Concrete – Short Form.
- .2 Show the elevation of all walls showing reinforcing V (vert.), H (horiz.) and corner bars, etc. Indicate bar sizes, spacing, location and quantities of reinforcement, mesh, mechanical splices, chairs, spacers and hangers with identifying code marks to permit correct placement without reference to structural drawings, as per Reinforcing Steel Manual of Standard Practice by Reinforcing Steel Institute of Ontario.
- .3 Detail lap lengths and bar development lengths to CSA A23.3, unless otherwise indicated. Provide Type B tension lap splices to CSA A23.3 unless otherwise indicated.
- .4 Design and detail lap lengths and bar development lengths to CSA A23.3, unless otherwise indicated.
- .5 Each drawing submitted to bear signature and stamp of qualified professional engineer registered in Province of P.E.I.
- .6 Do not reproduce the Consultant's Contract Structural Drawings in the preparation of Shop Drawings.

**1.4 SOURCE QUALITY CONTROL**

- .1 Upon request, provide Consultant with certified copy of mill test report of reinforcing steel, showing physical and chemical analysis, prior to commencing reinforcing work.

**Part 2 - Products****2.1 MATERIALS**

- .1 Substitute different size bars only if permitted in writing by Consultant.
- .2 Reinforcing steel: billet steel, Grade 400, deformed bars to CSA-G30.18, unless indicated otherwise.
- .3 Reinforcing steel: weldable low alloy steel deformed bars to CAN/CSA-G30.18.
- .4 Welded steel wire fabric: to CSA G30.5. Provide in flat sheets only.
- .5 Chairs, bolsters, bar supports, spacers to CSA-A23.1.
- .6 Mechanical splices: subject to approval of Consultant.
- .7 Plain round bars: to CSA-G40.21.
- .8 No pieces of stone or timber will be allowed as reinforcement support. Use concrete bricks or steel chairs.
- .9 Provide chairs to support wire mesh over steel deck and on compacted base for slab on grade (wire mesh to be placed in the center of concrete slab).
- .10 Do not walk on reinforcement. Provide plywood on top of reinforcement for walking.

**2.2 FABRICATION**

- .1 Fabricate reinforcing steel in accordance with CSA-A23.1 and Reinforcing Steel Manual of Standard Practice by the Reinforcing Steel Institute of Canada.
- .2 Obtain Consultant's approval for locations of reinforcement splices other than those shown on steel placing drawings.
- .3 Fabricate steel bar or rod mats clipped together in accordance with CSA G30.5 using bars to CSA G30.18, grade 400.
- .4 Upon approval of Consultant, weld reinforcement in accordance with CSA W186.
- .5 Ship bundles of bar reinforcement, clearly identified in accordance with bar bending details and lists.

**Part 3 - Execution****3.1 FIELD BENDING**

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

**3.2 PLACING REINFORCEMENT**



- .1 Place reinforcing steel as indicated on reviewed Shop Drawings and in accordance with CSA-A23.1.
- .2 Paint portion of dowel intended to move within hardened concrete with one coat of asphalt paint. When paint is dry, apply a thick even film of mineral lubricating grease.
- .3 Obtain Consultant's approval of reinforcing steel and position.
- .4 Clean concrete reinforcement before placing concrete, including removal of concrete laitance, ice and snow.
- .5 Wire mesh in the slab on grade shall be placed in the center of slab. The mesh should be placed on chairs or other suitable supports to keep in place and provide proper cover.
- .6 Installation of wire mesh by any method other than paragraph 3.2.5 above will not be accepted.
- .7 All dowels and anchor bolts shall be placed and tied to main reinforcement before placing concrete and not pushed in/through after the concrete is poured.

**-- END OF SECTION --**

**Part 1 General****1.1 RELATED REQUIREMENTS**

- .1 Section 03 10 00 – Concrete Formwork

**1.2 REFERENCE STANDARDS**

- .1 ASTM International
  - .1 ASTM A615/A615M-12, Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement.
  - .2 ASTM C260, Standard Specification for Air-Entraining Admixtures for Concrete.
  - .3 ASTM C309, Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete.
  - .4 ASTM C494/C494M, Standard Specification for Chemical Admixtures for Concrete.
  - .5 ASTM C1017/C1017M, Standard Specification for Chemical Admixtures for Use in Producing Flowing Concrete.
- .2 CSA Group
  - .1 CSA-A23.1/A23.2-14, Concrete Materials and Methods of Concrete Construction/Methods of Test and Standard Practices for Concrete.
  - .2 CSA A3000-1, Cementitious Materials Compendium (Consists of A3001, A3002, A3003, A3004 and A3005).
  - .3 CAN/CSA-G30.18, Carbon Steel Bars for Concrete Reinforcement

**1.3 ADMINISTRATIVE REQUIREMENTS**

- .1 Pre-installation Meetings: convene pre-installation meeting one week prior to beginning concrete works.
  - .1 Verify project requirements.

**1.4 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
  - .1 Submit manufacturer's instructions, printed product literature and data sheets for proprietary materials used in Cast-In-Place Concrete and additives and include product characteristics, performance criteria, physical size, finish and limitations.
  - .2 Submit 2 copies of WHMIS SDS in accordance with Section 01 35 43- Environmental Procedures.
- .3 Shop Drawings:
  - .1 Submit drawings stamped and signed by professional engineer licensed to practice in Nova Scotia.
    - .1 Submit placing drawings prepared in accordance with plans to clearly show size, shape, location and necessary details of reinforcing.

- .2 Submit drawings showing formwork and falsework design to: CSA A23.1/A23.2.
- .2 Submit drawings stamped and signed by professional engineer licensed to practice in Nova Scotia.
- .4 Samples:
  - .1 Minimum 4 weeks prior to beginning Work, submit 2 samples for review and acceptance of materials proposed for use as follows:
    - .1 Curing compound
    - .2 Joint filler
    - .3 Waterstops
    - .4 Supplementary cementing materials.
    - .5 Blended hydraulic cement.
    - .6 Admixture.
    - .7 Fine and coarse aggregate.
    - .8 Fly ash.
  - .5 Provide for review by Representative and do not proceed without written approval when deviations from mix design or parameters found.
  - .6 Quality Assurance Submittals:
    - .1 Submit in accordance with Section 01 45 00 - Quality Control

## **1.5 QUALITY ASSURANCE**

- .1 Provide to the Representative, 4 weeks minimum prior to starting concrete work, valid and recognized certificate from plant delivering concrete.
- .2 Quality Control Plan: provide written report to Representative verifying compliance concrete in place meets performance requirements.

## **1.6 DELIVERY, STORAGE AND HANDLING**

- .1 Delivery and Acceptance Requirements:
  - .1 Concrete hauling time: deliver to site of Work and discharged within 120 minutes maximum after batching.
    - .1 Modifying maximum time limit without receipt of prior written agreement from concrete producer as described in CSA A23.1/A23.2 is prohibited.
    - .2 Deviations submitted for review by Representative.
  - .2 Concrete delivery: ensure continuous concrete delivery from plant meets CSA A23.1/A23.2.
  - .3 Packaging Waste Management: in accordance with Section 01 74 19 - Waste Management and Disposal.

## **1.7 AMBIENT CONDITIONS**

- .1 Placing concrete during rain or weather events damaging to concrete is prohibited.
- .2 Protect newly placed concrete from rain or weather events in accordance with CSA A23.1/A23.2.

- .3 Cold weather protection:
  - .1 Maintain protection equipment, in readiness on Site.
  - .2 Use such equipment when ambient temperature below 5°C, or when temperature may fall below 5°C before concrete cured.
  - .3 Placing concrete upon or against surface at temperature below 5°C is prohibited.
- .4 Hot weather protection:
  - .1 Protect concrete from direct sunlight when ambient temperature above 27°C.
  - .2 Prevent forms of getting too hot before concrete placed. Apply accepted methods of cooling not to affect concrete adversely.
- .5 Protect from drying.

## **Part 2 Products**

### **2.1 DESIGN CRITERIA**

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

### **2.2 PERFORMANCE CRITERIA**

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

### **2.3 MATERIALS**

- .1 Portland Cement: Normal GU.
- .2 Hydraulic cement: Type GUB to CSA A3001.
- .3 Water: to CSA A23.1/A23.2.
- .4 Reinforcing bars:
  - .1 Billet steel, grade 400, deformed bars to CSA-G30.18, unless indicated otherwise.
- .5 Pre-moulded joint filler:
  - .1 Bituminous impregnated fibreboard: to ASTM D1751.
- .6 Joint sealer/filler: grey to ASTM C 920, Type M, Grade NS.
- .7 Sealer: proprietary poly-siloxane resin blend.
- .8 Other concrete materials: to CSA A23.1/A23.2.

### **2.4 MIXES**

- .1 Alternative 1 - Performance Method for specifying concrete: to meet Representative performance criteria to CSA A23.1/A23.2.
  - .1 Ensure concrete supplier meets performance criteria as established below and provide verification of compliance as described in PART 3 - VERIFICATION.

- .2 Provide concrete mix to meet following hard state requirements:
  - .1 Durability and class of exposure: C-1.
  - .2 Compressive strength at 28 age: 35 MPa minimum.
  - .3 Intended application: Exterior Slabs
  - .4 Aggregate size: 19mm
  - .5 Volume stability: acceptable volume change range
- .3 Concrete supplier's certification.
- .4 Provide quality management plan to ensure verification of concrete quality to specified performance.

### **Part 3 Execution**

#### **3.1 PREPARATION**

- .1 Provide Representative 24 hours notice before each concrete pour.
- .2 Place concrete reinforcing in accordance with Section 03 20 00- Concrete Reinforcing.
- .3 During concreting operations:
  - .1 Development of cold joints not allowed.
  - .2 Concrete delivery and handling to facilitate placing with minimum of rehandling, and without damage to existing structure or Work.
- .4 Protect previous Work from staining.
- .5 Clean and remove stains prior to application of concrete finishes.

#### **3.2 INSTALLATION/APPLICATION**

- .1 Do cast-in-place concrete work in accordance with CSA A23.1/A23.2.
- .2 Sleeves and inserts:
  - .1 Cast in sleeves, ties, slots, anchors, reinforcement, frames, conduit, bolts, waterstops, joint fillers and other inserts required built-in.
  - .2 Sleeves and openings minimum 100 mm x 100 mm not indicated, reviewed by Representative.

#### **3.3 FINISHES**

- .1 Formed surfaces exposed to view: in accordance with CSA A23.1/A23.2.
- .2 Finishing operations followed by final finishing comprising mechanical floating and steel trowelling as specified in CSA A23.1/A23.2 to produce hard, smooth, dense trowelled surface free from blemishes.
- .3 Equipment pads: provide smooth trowelled surface.
- .4 Pavements, walks, curbs and exposed site concrete:
  - .1 Screed to plane surfaces and use wood floats.
  - .2 Provide round edges and joint spacings using standard tools.
  - .3 Trowel smooth and provide lightly brushed non-slip finish.

**3.4 CONTROL JOINTS**

- .1 Cut control joints in slabs on grade at locations indicated, to CSA A23.1/A23.2 and install specified joint sealer/filler.

**3.5 EXPANSION AND ISOLATION JOINTS**

- .1 Install pre-moulded joint filler in expansion and isolation joints full depth of slab flush with finished surface to CSA A23.1/A23.2.

**3.6 CURING**

- .1 Use curing compounds compatible with applied finish on concrete surfaces free of bonding agents and to CSA A23.1/A23.2.

**3.7 SITE TOLERANCES**

- .1 Concrete floor slab finishing tolerance to CSA A23.1/A23.2.

**3.8 FIELD QUALITY CONTROL**

- .1 Concrete testing: to CSA A23.1/A23.2 by testing laboratory designated and paid for by Representative.

**3.9 CLEANING**

- .1 Clean in accordance with Section 01 74 00- Cleaning.
- .2 Use trigger operated spray nozzles for water hoses.
- .3 Designate cleaning area for tools to limit water use and runoff.
- .4 Cleaning of concrete equipment in accordance with Section 01 35 43 Environmental Procedures.
- .5 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 19 – Waste Management and Disposal.
  - .1 Provide appropriate area on job site where concrete trucks can be safely washed.
  - .2 Divert admixtures and additive materials from landfill to approved official hazardous material collections site after receipt of written approval from Representative.
  - .3 Disposal of unused admixtures and additive materials into sewer systems, into lakes, streams, onto ground or in other location posing health or environmental hazard is prohibited.

-- END OF SECTION --

**Part 1 – General****1.1 GENERAL**

- .1 The general conditions of this contract as well as the provisions of Division 1 are part of and to be read in conjunction with this section.

**1.2 ELECTRICAL WORK INCLUDED**

- .1 The specification complements the drawings in describing the supply and installation of a complete standby generator system at North River Lagoon UV building, Warren Grove lift station and River point Water station. These 3 generators systems shall be installed and integrated into the existing electrical infrastructure. This system shall include but not necessarily be limited to the following:
  - .1 Diesel Generator complete with sub-base fuel tank;
  - .2 Automatic transfer switch;
  - .3 Power and control cables for a standby power system;
  - .4 Alarm and status signals, including wiring;
  - .5 Distribution panel;
  - .6 Demolition and removal of existing as noted.

**1.3 CONTRACT DRAWINGS**

- .1 The specification together with the drawings are intended to provide a description of a complete electrical system and therefore there shall be no omission of the items necessary or required to make a finished, workmanlike, first-class installation, even though each and every item of labour and material may not be mentioned in the specification or shown on the drawings.
- .2 Items indicated on floor plans and not on riser diagrams, or vice versa, shall be considered fully covered by both.
- .3 Runs of conduit and outlet locations indicated on the drawings are diagrammatic and exact locations must be determined by this contract as the work proceeds, with due regard to the structure and the work of other trades. This contract shall make any changes dictated by structural requirements, or conflicts with other trades, without charge.
- .4 Apparent errors or omissions shall be referred to the Departmental Representative whose decision shall be final.
- .5 Building dimensions shall not be scaled from the electrical drawings but shall be obtained from the architectural and/or structural drawings. Any discrepancy between the drawings and building shall be questioned before proceeding with the installation.

**1.4 CODES AND STANDARDS**

- .1 As a minimum standard perform all work in accordance with the requirements of the Provincial Department of Labour, Canadian Electrical Code C22.1-2018 Part 1, National Building Code, and ULC-S524-2010. These standards together with all local or municipal rules, regulations, and ordinances shall be considered as the latest approved editions at the time of tender closing. In no instance, shall the standard established in these contract documents, be reduced by any codes.
- .2 Do underground systems in accordance with CSA CAN-C22.3 No. 7-94.

- .3 Abbreviations for electrical terms: to CSA Z85-2015.
- .4 Comply with CAN/CSA C860-96 standard for exit signs.
- .5 Comply with efficiency values as indicated in the latest version of CSA C802.2 Minimum Efficiency Values for Dry Type Transformers. Transformers to bear label of verification agency logo near nameplate.
- .6 Comply with CSA Certification Standards and Electrical Bulletins in force at the time of tender submission.

### **1.5 INSPECTIONS, PERMITS AND FEES**

- .1 Obtain all inspections and permits required by all laws, ordinances, rules and regulations by the public authority having jurisdiction at the place of this building for work of this Contract, and obtain certificates of such inspections and submit same and pay all charges in connection therewith. The final certificate of inspection shall be obtained before final payment for work shall be considered due.
- .2 Electrical Permit
  - .1 Submit to the Electrical Inspection Department and Supply Authority necessary number of drawings and specifications for examination and approval prior to commencement of work.
  - .2 Pay associated fees.
  - .3 Furnish certificates of Acceptance from Inspection Department and AHJ on completion of work.

### **1.6 SHOP DRAWINGS, PRODUCT DATA AND SAMPLES**

- .1 Submit shop drawings, product data and samples in accordance with Division 1. Provide all shop drawings within 30 days after contract has been awarded. Failure to do so will delay progress payments.
- .2 Indicate details of construction, dimensions, capacities, weights and electrical performance characteristics of equipment or material.
- .3 Where applicable, include wiring, single line and schematic diagrams.
- .4 Include wiring drawings or diagrams showing interconnection with work of other Sections.
- .5 Keep one copy of shop drawings and product data on site, available for reference at all times.

### **1.7 OPERATION AND MAINTENANCE DATA**

- .1 Provide operation and maintenance data for incorporation into Operation and Maintenance Manuals as specified in Division 1.
- .2 Include in the operation and maintenance data:
  - .1 Details of design elements, construction features, component function, and maintenance requirements to permit effective start up, operation, maintenance, repair, modification, extension, and expansion of any portion or feature of installation.



- .2 Technical data, product data, supplemented by bulletins, component illustrations, exploded views, technical description of items and parts lists. **Advertising or sales literature not acceptable.**
- .3 Wiring and schematic diagrams and performance curves.
- .4 Names and addresses of local suppliers for items included in maintenance manuals.
- .5 Copy of reviewed shop drawings.
- .6 Signed receipt for all spare parts.
- .3 Approvals:
  - .1 Submit one draft of Operating and Maintenance Manual to Departmental Representative for approval one month prior to estimated substantial completion date. Submission of individual data will not be accepted unless so directed by Departmental Representative.
  - .2 Make any changes in submission as may be required and re-submit as directed.
  - .3 Failure to do so will result in delay of progress payment.
  - .4 Provide two (2) final bound copies of Operation and Maintenance Manuals to Departmental Representative.

## 1.8 PROJECT RECORD DOCUMENTS

- .1 Provide Project Record Documents in accordance with Division 1.
- .2 Submit record drawings to Departmental Representative showing changes of wire sizes, circuit numbering and location of raceways, fittings, fixtures, panels and equipment, and their sizes, the location of which has changed or deviated during the work.
- .3 Submit sepia or reproducible of record drawings after record drawings have been approved by the Departmental Representative. Originals shall be made available by the Departmental Representative for the making of sepia or reproducible of the contract drawings. All changes reflected on record drawings are to be indicated on these sepia or reproducible.

## 1.9 MAINTENANCE MATERIAL

- .1 Provide maintenance materials in accordance with Division 1.

## 1.10 CARE, OPERATION AND START UP

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

**1.11 VOLTAGE RATINGS**

- .1 Operating voltages to meet requirements of CAN3-C235.
- .2 Motors, control and distribution equipment to operate satisfactorily at 60 Hz within normal operating limits established by the above standard. Equipment to operate in extreme operating conditions established in the above standard without damage to the equipment.

**1.12 MATERIAL AND EQUIPMENT**

- .1 Provide materials and equipment in accordance with Division 1.
- .2 Equipment and materials to be C.S.A. certified and manufactured to standard quoted.
- .3 Where there is no alternative to supplying equipment which is not C.S.A. certified, obtain special approval from C.S.A.
- .4 Factory assemble control panels and component assemblies.
- .5 For the purposes of uniformity similar materials shall be of one manufacturer (i.e. all panels; all motor control equipment; all fixtures in as much as is possible, etc.).
- .6 To avoid the possibility of the work being delayed, order all materials as soon as the shop drawings are reviewed, and report at once to the Departmental Representative any delays in the delivery of materials which would hold up the completion of the job.

**1.13 GROUNDING**

- .1 All equipment and exposed non-current carrying metal, conduits and parts shall be permanently and effectively grounded to meet minimum requirements of the C.E.C. Section 10, and as indicated on the drawings and further specified. Standards set either by drawings or specifications which are above those covered by C.E.C. Section 10, shall not be reduced under any circumstances.

**1.14 ELECTRIC MOTOR, EQUIPMENT AND CONTROLS**

- .1 Not Applicable.

**1.15 FINISHES**

- .1 Shop finish metal enclosure surfaces by removal of rust and scale, cleaning, application of rust resistant primer inside and outside, and at least two coats of finish enamel.
  - .1 Paint outdoor electrical equipment, "Equipment Green" finish to EEMAC Y1-1-1955.
  - .2 Paint indoor switchgear and distribution enclosures light grey to EEMAC 2Y-1-1958.
- .2 Clean and touch up surfaces of shop-painted equipment scratched or marred during shipment or installation, to match original paint.
- .3 Clean, prime and paint exposed hangers, racks, and fastenings to prevent rusting.
- .4 Where wire guards are specified in other sections, they are to be constructed of stainless steel. Painted steel is not acceptable.

**1.16 EQUIPMENT IDENTIFICATION**

- .1 All switchboards, motor control centres, disconnect switches, dry-type transformers starters, pushbuttons, panels, etc., shall have "Lamacoid" nameplates mounted on or adjacent for identification which shall include the panel designation, voltage, phase, wires overcurrent protection, H.P., KW and amperage as applicable. The nameplates shall be affixed to equipment with permanent adhesive backing.
- .2 Install directories on the back of each door of panel boards, neatly arranged and mounted in frame under transparent cover. Directories shall be typed and shall show system voltage, which outlets are on each circuit and any special information, such as sizes of fuses, etc., necessary for the proper operation and maintenance of the system.
- .3 All sectionalising panels shall have lamacoid plates affixed adjacent to each breaker.
- .4 Size of identification shall be suitable for equipment and importance of information.
- .5 All fused disconnect switches shall have lamacoid plates identifying the equipment they feed and a separate plate indicating maximum fuse size and type.
- .6 Lettering shall be of sufficient size to be readable from normal viewing distance and the information required on the nameplates shall dictate the physical size of plates.
- .7 Nameplates shall have white lettering on black background except for equipment connection to stand-by power source, which shall have white lettering on red background.
- .8 All transformers to have lamacoid plates identifying source of primary feeder and secondary equipment which it feeds plus distribution designation lettering and/or numbers.
- .9 All "D" and "E" boxes 200 x 200 x 100" or larger and "C" and "T" cabinets shall have lamacoid plates affixed indicating voltages and/or systems housed within.
- .10 Nameplates:
  - .1 Lamicoid 1/8" thick plastic engraving sheet.
 

<u>NAMEPLATE SIZES</u>			
Size 1	10mm x 50mm	1 line	1/8" high letters
Size 2	13mm x 69mm	1 line	1/8" high letters
Size 3	13mm x 69mm	2 lines	1/8" high letters
Size 4	19mm x 91mm	1 line	3/8" high letters
Size 5	19mm x 91mm	2 lines	1/4" high letters
Size 6	25mm x 100mm	1 line	1/2" high letters
Size 7	25mm x 100mm	2 lines	1/4" high letters
- .11 Labels:
  - .1 Embossed plastic labels with 6.5mm high letters unless specified otherwise.
- .12 Wording on nameplates and labels to be approved by the Departmental Representative prior to manufacture.
- .13 Allow for average of twenty-five (25) letters per nameplate and label.
- .14 Identification to be English.

**1.17 WIRING IDENTIFICATION**

- .1 Identify wiring with coloured plastic tapes, on both ends of phase conductors for feeders.
- .2 Maintain phase sequence and colour coding throughout.
- .3 Colour code to meet requirements of CSA C22.1-1998.
- .4 Use color coded wires in branch circuit wiring, systems wiring and communication cables.

**1.18 CONDUIT AND CABLE IDENTIFICATION**

- .1 Identify conduit and metallic sheathed cable runs for the various systems with 25mm coloured bands placed on conduit run every 3 metres of length and at least one should appear in each room and at points where conduit or cable enters wall, ceiling or floor.
- .2 

<u>System</u>	<u>Colour</u>
120/208V Lighting & Power	Yellow

**1.19 WIRING TERMINATION**

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

**1.20 MANUFACTURERS AND CSA LABELS**

- .1 Manufacturers and CSA labels shall be visible and legible after equipment is installed.

**1.21 WARNING SIGNS**

- .1 Provide warning signs, as specified and/or to meet the requirements of the Department of Labour Inspection Department.
- .2 Use decal signs, minimum 175mm x 250mm size.

**1.22 SINGLE LINE DIAGRAMS**

- .1 Not Applicable.

**1.23 LOCATION OF OUTLETS**

- .1 Not Applicable.

**1.24 MOUNTING HEIGHTS**

- .1 Not Applicable.

**1.25 PROTECTION**

- .1 Protect exposed live equipment during construction for personnel safety.
- .2 Shield and mark live parts "LIVE 120 VOLTS" or with appropriate voltage in English.

- .3 Arrange for installation of temporary doors for rooms containing electrical distribution equipment. Keep these doors locked except when under direct supervision of electrician.

## **1.26 LOAD BALANCE**

- .1 Balance all phase currents of transformers, main switchboard, distribution Panel boards, etc., and where applicable, adjust transformer taps to obtain within 2% of the rated voltage of the load being supplied. Make adjustments and/or increase conductor size so as to limit voltage drops to 3% and make such adjustments under average load conditions in presence of Departmental Representative.
- .2 Submit to Departmental Representative, at completion of work, a report listing the voltage, phase and neutral currents on the switchboard, Panel boards and dry-type transformers, operating under normal load. On the report, also state hour and date on which each load was measured.

## **1.27 CONDUIT AND CABLE INSTALLATION**

- .1 Install conduit, and sleeves, prior to pouring of concrete. Sleeves through concrete shall be constructed of sheet metal, sized for free passage of conduit, and protruding 50mm.
- .2 Install cables, conduits, and fittings to be embedded neatly and close to building structure so furring can be kept to minimum.

## **1.28 FIRESTOPPING AND SMOKE SEALS**

- .1 Not Applicable.

## **1.29 TESTS**

- .1 Conduct and pay for tests of the following:
  - .1 Power distribution system including phasing, voltage, grounding and load balancing.
  - .2 Circuits originating from branch distribution panels.
  - .3 Lighting and its control.
- .2 Furnish manufacturer's certificate or letter confirming that entire installation as it pertains to each system has been installed to manufacturer's instructions.
- .3 Carry out tests in presence of Architect and/or Engineer. Notify Architect and/or Engineer seven (7) days in advance of time testing will take place.
- .4 Provide instruments, meters, equipment and personnel required to conduct tests during and at conclusion of project.
- .5 The Architect and/or Engineer reserves the right to use any piece of electrical equipment, device, or material installed under this contract for such reasonable lengths of time and at such times as he may require to make a complete and thorough test of the same, before the final completion and acceptance of the work.
- .6 Such tests shall not be construed as acceptance of any part of the work.
- .7 Submit test results for Architect's and/or Engineer's review.

**1.30 INSULATION RESISTANCE TESTING**

- .1 Test all wiring, included in the work to ensure that there are no shorts and/or grounds are present on phase conductors for feeders or branch circuits and that insulation values are as required by the Canadian Electrical Code.
- .2 All testing of conductors to be done prior to energization of conductors with 600 volt and 1000 volt meggers as required by the Canadian Electrical Code.
- .3 Capacitive leakage testing of all phases and neutral feeder conductors at various systems originating points, are to be recorded for each individual feeder with test results to be submitted to Departmental Representative for approval.
- .4 Systems to be tested for capacitive leakage are as follows: 120/208V/3PH/4W, and 347/600V/3PH./4W.
- .5 Check resistance to ground before energizing. Ensure resistance to ground is not less than 50 megohms.
- .6 Submit test results for Departmental Representative's review. Test results shall include time of test, feeder tested, and instrument readings.

**1.31 COORDINATION OF PROTECTIVE DEVICES**

- .1 Not Applicable.

**1.32 CLEANING**

- .1 Do final cleaning in accordance with Division 1.
- .2 At time of final cleaning, clean lighting reflectors, lenses and other lighting surfaces that have been exposed to construction dust and dirt.
- .3 On completion of work, remove debris resulting from work of this Division and leave the site neat and tidy. Equipment shall be checked for proper fitting and alignment, adjusted, cleaned, repainted where necessary, and left in first class condition.
- .4 This section shall be responsible for the removal of spatters, droppings, soil, labels, and debris from finished surfaces and from surfaces to receive finishes, before the set up. Work and adjacent finished work shall be left in new condition.
- .5 Only cleaning materials which are recommended for the purpose by both the manufacturer of the surface to be cleaned and of the cleaning material shall be used.
- .6 Immediately before and during finishing work shall be made "broom clean". Interior areas shall be "vacuum cleaned" immediately before finish painting commences.
- .7 Material at site cannot be burned or buried except as approved by Departmental Representative. Removal shall be as often as required to avoid accumulation in order to ensure site is maintained clean.
- .8 Volatile fluid wastes cannot be disposed of in storm or sanitary sewers or in open drain courses.
- .9 Lowering of materials shall be controlled and shall not be dropped or thrown from stories above grade.

**1.33 COORDINATION**

- .1 Cooperate and investigate with other trades to make maximum use of the spaces. Avoid conflicts with pipes, ducts, etc. Prepare shop drawings indicating the route of main conduits and ducts for submission to the Departmental Representative for approval.
- .2 Cooperate with other trades on the site and carry out the work, in such a way, as not to hinder or hold up the work of other trades.
- .3 Consult with other trades, where their respective installations conflict and re-route conduits, ducts, outlets, equipment, etc., as required, subject to the approval of the Departmental Representative.
- .4 Obtain from the mechanical and other trades complete detailed wiring diagrams of equipment requiring connections and be responsible for pointing out any discrepancies or the reason why they cannot be adhered to.
- .5 Locate all light fixtures, speakers, smoke detectors, etc. using Departmental Representative reflected ceiling plan as a guide.

**1.34 SUPERVISION**

- .1 Provide supervision and sufficiently qualified foreman for work of this Contract to ensure that the work proceeds in proper and efficient manner to its completion. If in the opinion of the Departmental Representative, such personnel are not competent to carry out the work, replace these men immediately upon written request of the Departmental Representative.

**1.35 COMMISSIONING OF ELECTRICAL SYSTEMS**

- .1 Upon receipt of written verification from the Contractor that:
  - .1 All systems are complete and operational in all respects.
  - .2 All specified reports and documents have been submitted and approved.
  - .3 All demonstrations have been completed and documented; the Engineer will commence a systems' commissioning period.
- .2 During this period of not more than 20 working days, the Engineer will verify the operation of all systems. The commissioning process may involve real or simulated conditions to determine the systems full operational capabilities. Copies of all specified reports and documents are to be available on site during the commissioning period.
- .3 During the commissioning process, the on-site foreman of the electrical subtrade involved in the supervision of the work plus one electrician is to be on site providing full-time assistance to the Engineer. In addition, systems' suppliers' representatives are to be available to be on site providing full-time assistance to the Engineer within 48 hours' notice to assist in the verification of their respective systems.
- .4 All necessary equipment such as meters, load banks, etc., required to fully commission the systems are to be made available to the Engineer.
- .5 Deficiencies or discrepancies discovered during the commissioning process are to be immediately rectified. Exceptional arrangements for labour and materials will be required to correct deficiencies, which prevent the satisfactory completion of the commissioning process.

**1.36 ELECTRICAL ROOM LAYOUTS**

.1 Not Applicable.

**1.37 ACCESS DOORS**

.1 Not Applicable.

**1.38 UTILITY SERVICES**

.1 Not Applicable.

**1.39 SPRAY FIRE PROOFING**

.1 Not Applicable.

**1.40 SPRINKLER PROOF HOODS**

.1 Not Applicable.

**1.41 CONCRETE HOUSE KEEPING PADS**

.1 Not Applicable.

**-- END OF SECTION --**



**Part 1 – General****1.1 REFERENCE STANDARDS**

- .1 CSA C22.2 No. 18 - Clamps and connectors.
- .2 CSA C22.2 No. 65 Wire Connectors.

**1.2 RELATED WORK**

- .1 Not Applicable

**1.3 SHOP DRAWINGS AND PRODUCT DATA**

- .1 Not Applicable

**1.4 OPERATION AND MAINTENANCE DATA**

- .1 Not Applicable

**Part 2 - Products****2.1 MATERIALS**

- .1 All connections shall be made electrically and mechanically secure. Sizes of connectors shall be according to manufacturer's recommendations for each size and combination of wires.
- .2 Joints required in branch wiring #10 AWG and smaller shall be made using fixture twist-on type connectors with current carrying parts made of copper.
  - .1 Standard of Acceptance: Marrette #31, #33 or #35 as required.
- .3 Joints for wiring #8 AWG and larger shall be made using pressure type colour keyed compression connectors with current carrying parts made of copper using compression tools. A first layer of tape shall be compound type followed by a layer of Scotch #3 vinyl type.
  - .1 Standard of Acceptance: 54000 series.
- .4 Bushing stud connectors: As required to suit conductors.
- .5 Clamps or connectors for armoured cable and flexible conduit as required.

**Part 3 - Execution****3.1 INSTALLATION**

- .1 Remove insulation carefully from ends of conductors and:
  - .1 Install mechanical pressure type connectors and tighten screws with appropriate compression tool recommended by manufacturer. Installation shall meet secureness tests in accordance with CSA C22.2 No. 65.
  - .2 Install fixture type connectors and tighten. Replace insulating cap.
- .2 All connections shall be made electrically and mechanically secure. Sizes of connectors shall be according to manufacturer's recommendations for each wire size and combination of wires. Twist wires together before installing connectors. All stranded conductors shall be twisted together prior to connection around terminal.

**- - END OF SECTION - -**

**Part 1 – General****1.1 REFERENCE STANDARDS**

- .1 CSA C22.2 No. 38 - Thermoset insulated Wires and Cables.
- .2 CSA C22.2 No. 51 - Armoured cables.
- .3 Wire and cable shall conform to the latest specification of the Canadian Standards Association (CSA), Electrical and Electronic Manufacturers Association of Canada (EEMAC), the Insulated Power Cable Engineers Association (IPCEA), and the American Society of Testing Materials (ASTM).

**1.2 RELATED WORK**

- .1 Not Applicable

**1.3 SHOP DRAWINGS AND PRODUCT DATA**

- .1 Submit product data in accordance with Division 1.

**1.4 OPERATION AND MAINTENANCE DATA**

- .1 Not Applicable

**Part 2 - Products****2.1 BUILDING WIRES**

- .1 Conductors: Copper, soft drawn stranded, at least 98% conductivity for #10 AWG and larger. Insulation shall be chemically cross-linked thermosetting polyethylene rated 600 volts on all RW90 conductors and 1000 volts for RWU-90 for incoming service. Size as indicated on drawings and schedules. Conductor insulation shall be colour coded as follows:
  - Phase A - Red
  - Phase B - Black
  - Phase C - Blue
  - Neutral - White
  - Ground - Green
  - Isolated Power - as indicated hereinafter.

Where extra colours are required for three-way switches, etc., they shall be yellow.

Approved color-coded tape is acceptable for color coding phase conductors #1 AWG and larger and for neutral and ground conductors #4/0 and larger.

**2.2 CONTROL CABLES**

- .1 600 V Type: 2 stranded copper conductors, 95% conductivity, full size AWG gauge, sizes as indicated with PVC insulation Type TW with shielding of magnetic tape wire braid over each pair of conductors and overall covering of thermoplastic jacket. Colour code shall be orange and brown.

**2.3 ARMOURED CABLES**

- .1 Conductors: insulated, copper, size as indicated.
- .2 Type: AC90.
- .3 Armour: interlocking type fabricated from aluminum strip.
- .4 Connectors: to manufacturer's recommendations.

## **2.4 TECK CABLE**

- .1 Not Applicable.

## **2.5 SYSTEM WIRING**

- .1 Wiring for auxiliary systems will be as indicated in specification or on drawings and/or as recommended by Manufacturer of the system.

## **2.6 MANUFACTURERS**

- .1 Standard of Acceptance: Nexans or approved equal.

### **Part 3 - Execution**

#### **3.1 INSTALLATION OF BUILDING WIRES**

- .1 Install all building wiring as follows:
  - .1 In conduit systems in accordance with Section 26 05 34.

#### **3.2 INSTALLATION OF CONTROL CABLES**

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

#### **3.3 INSTALLATION OF ARMoured CABLES**

- .1 Group cables wherever possible.
- .2 Flexible type conduit c/w RW90 conductors sized as noted and or flexible armoured cable AC90 (BX) complete with separate grounding conductor shall be used for all bench or counter wiring of receptacles or other devices.
- .3 AC-90 cable or RW90 in flex is to be used for fixture drops only unless otherwise noted on the Drawings. AC 90 (BX) cable used for fixture drops minimum size of No. 12. Total length of any individual AC-90 cable or flex c/w RW90 not to exceed 3000mm in length. The use of AC90 between rooms is not permitted.
- .4 These fixture drops to be run from the junction box in respective rooms and not run to fixtures in any other adjacent rooms.
- .5 All flex c/w RW90 or AC-90 cables used for fixture drops are to be secured within 300mm of the junction box.
- .6 Where application of AC-90 cables and/or other types of pliable cables are to be used, they shall be installed parallel or perpendicular to the building lines unless otherwise noted.

- .7 Support and securing of type AC-90 cables not to be derived from either suspended ceiling support wires or directly laying atop of the ceiling grid system.

### 3.4 INSTALLATION OF TECK CABLE

- .1 Not Applicable.

### 3.5 INSTALLATION - GENERAL

- .1 Where pulling wires and cables, the use of an approved lubricant only will be permitted. No wires or cables shall be pulled in conduits until such conduits are free from moisture and in no case shall wires be pulled until approval of the Departmental Representative is obtained.
- .2 All stranded conductors prior to terminating under device bolts such as circuit breakers, light switches, receptacles, etc., to be twisted together to form a single conductor to ensure a reliable mechanical connection.
- .3 "Labelling" of all branch circuit wiring including phase conductors, neutrals, ground and/or bonding conductors to be done on **both ends** of all circuit wires plus in any junction and/or pull boxes located in between using "Panduit" write-on, self laminating labels Nos. PDL-1 and PDL-2 as required.
- .4 The following wiring methods are designed to enhance the ability to perform capacitive leakage tests:
- .1 All circuit conductors are to be individually tie wrapped to their corresponding labelled neutral conductor in all panelboards, pullboxes and junction boxes. Enough slack conductor length should be left to enable the ability to clamp the ground detector around the individually tie-wrapped circuit conductor and its corresponding labelled neutral. This wiring method is to be neat and of good workmanship quality.
  - .2 The tie wrapping of the neutral with its respective phase conductors is to be made at the closest point of entry into panelboards, pullboxes and junction boxes.
  - .3 The main switchboard, CDP's, panelboards, MCC's etc, are to have their respective feeder phase and neutral conductors tie-wrapped together and enough slack conductor length to enable the ability to clamp the ground detector around each set of feeders. This wiring method is to be neat and of good workmanship quality.
  - .4 After all electrical wiring has been completed by the Electrical Sub-Contractor, he is to test the grounded electrical distribution system to ensure there are not ground shorts and capacitive leakage in the system.
  - .5 All feeders or branch circuits which do not have neutral conductors are to have their respective phase conductors tie-wrapped together in accordance with the methods described previously.
  - .6 Run all circuits so that the voltage drop in no case exceeds 3% of the line volts. The neutral wire, wherever it is run, shall be continuous with no fuses, switches, or breaks of any kind.
  - .7 For 15 amp, 120 volt circuits the following table shall be used to determine the minimum conductor sizes required to compensate for voltage drop.
  - .8 Find below the branch circuit maximum lengths (120 volt one way length from panelboard to load including vertical drops. Do as to limit voltage drop to 3%).
    - .1 From 0.3m to 24m #12 Wire
    - .2 From 24m to 37m #10 Wire

- .3 From 37m to 55m #8 Wire
- .9 Increased wire sizes where required shall not be decreased in size in any portion of length of run between panelboard and the wiring device itself.
- .10 All wire shall be color coded as per Code requirements and/or as specified herein.

**-- END OF SECTION --**

**Part 1 – General****1.1 REFERENCE STANDARDS**

- .1 Not Applicable

**1.2 RELATED WORK**

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

**1.3 SHOP DRAWINGS AND PRODUCT DATA**

- .1 Submit shop drawings and product data in accordance with Division 1.

**1.4 OPERATION AND MAINTENANCE DATA**

- .1 Not Applicable

**Part 2 - Products****2.1 SUPPORT DEVICES**

- .1 U shape, size 41mm x 41mm, 2.5mm thick, surface mounted or suspended as required.
- .2 Supply and install all necessary inserts, rods, channels, brackets, etc., to form a support system capable of carrying at least twice the weight of the equipment supported.
- .3 In concrete, use cast-in threaded inserts wherever possible. Should additional inserts be required use a "red head" type of insert capable of carrying at least 45 kgs.
- .4 All hanger rods shall be 10mm diameter continuous threaded rod cut to required lengths.
- .5 All conduits not installed on unistrut or approved equal type support channels to be supported as follows:
  - .1 13mm up to and including 50mm conduits - one hole steel straps.
  - .2 50mm and larger sizes - two hole steel straps.
- .6 Beam clamps to secure conduit to exposed steel work.
- .7 All trays, wireways, and multiple conduits, shall be supported by a steel channel support system with all components, hangers, wall supports, cable clamps, etc., specifically manufactured and approved for their application.
- .8 Fastening devices for cabinets, boxes, supports, etc., shall be nut and bolt, ramset, expansion shields, wedge anchors, or toggle bolts, size and number to suit the application or as detailed on the drawings. Toggle bolts shall not be used in gypsum wallboard construction.
- .9 Fastening devices for outlet boxes shall be nut and bolt, ramset, expansion shields, wedge anchors or caddy clips, size and number to suit the application or as detailed on the drawings.

**2.2 MANUFACTURERS**

- .1 Standard of Acceptance: Burndy.
- .2 Other approved manufacturers: Erico, Electrovert, Pursley, Unistrut.

**Part 3 - Execution****3.1 INSTALLATION**

- .1 Secure equipment to hollow or solid masonry tile and plaster surfaces with lead anchors.
- .2 Secure equipment to poured concrete with expandable inserts.
- .3 Secure equipment to hollow masonry wall, or suspended ceilings with toggle bolts.
- .4 Secure surface mounted equipment with twist clip fasteners to inverted T bar ceilings. Ensure that T-bars are adequately supported to carry weight of equipment specified before installation.
- .5 Support equipment, conduit or cables using clips, spring loaded bolts, cable clamps designed as accessories to basic channel members.
- .6 Suspended support systems.
  - .1 Support individual cable or conduit runs with 10mm dia threaded rods and spring clips.
  - .2 Support 2 or more cables or conduits on channels supported by 10mm dia threaded rod hangers where direct fastening to building construction is impractical.
- .7 For surface mounting of two or more conduits use channels at 1.5m on center spacing.
- .8 Provide metal brackets, frames, hangers, clamps and related types of support structures where indicated or as required to support conduit and cable runs.
- .9 Ensure adequate support for raceways and cables dropped vertically to equipment where there is no wall support.
- .10 Do not use wire lashing or perforated strap to support or secure raceways or cables.
- .11 Do not use supports or equipment installed for other trades for conduit or cable support except with permission of other trade and approval of Departmental Representative.
- .12 Install fastenings and supports as required for each type of equipment cables and conduits, and in accordance with manufacturer's installation recommendations.
- .13 Coordinate the location of any insert to miss concrete reinforcement and obtain approval of Departmental Representative prior to installing.
- .14 Secure all equipment in a manner, so as not to distort or cause undue stress on any components.
- .15 Support of any equipment shall not rely on the strength of plaster, or gypsum board construction.

**-- END OF SECTION --**



**Part 1 – General****1.1 REFERENCE STANDARDS**

- .1 CSA C22.2 No. 18 - Outlet boxes, conduit boxes and fittings.

**1.2 RELATED WORK**

- .1 Not Applicable

**1.3 SHOP DRAWINGS AND PRODUCT DATA**

- .1 Not Applicable

**1.4 OPERATION AND MAINTENANCE MANUAL**

- .1 Not Applicable

**Part 2 - Products****2.1 OUTLET AND CONDUIT BOXES GENERAL**

- .1 Size boxes in accordance with Canadian Electrical Code, Part 1.
- .2 100mm square or larger outlet boxes as required for special devices.
- .3 Gang boxes where wiring devices are grouped.
- .4 Blank cover plates for boxes without wiring devices.
- .5 Combination boxes with CSA approved barriers where outlets for more than one system are grouped.
- .6 Outlet boxes for concealed use in frame construction shall be sectional, galvanized, pressed steel; these shall be restricted for use with flexible conduit AC-90 cable (where indicated) or other pliable type cable. The installation of any type of rigid type conduit in sectional boxes is prohibited. Where wire fill dictates larger boxes for outlets, use suitably sized square boxes, with raised "tile ring" style extension.

**2.2 SHEET STEEL OUTLET BOXES**

- .1 Electro-galvanized steel single and multi-gang flush **device boxes** for flush installation, minimum size 75 x 50 x 63mm or as indicated with a minimum volume of 262,192 cu. Mm (similar to Iberville # BC-3104-LSSAX). 100mm (4 inch) square outlet boxes when more than one conduit enters one side, with extension and tile rings (square, welded type) as required. For use in masonry construction, style MB (S or D) shall be used.
- .2 100 mm square or octagonal outlet boxes for lighting fixtures.
- .3 100mm square outlet boxes with extension and plaster rings for flush mounting special devices in finished plaster or tile walls.

**2.3 MASONRY BOXES**

- .1 Not Applicable.

**2.4 CONCRETE BOXES**

- .1 Not Applicable.

## 2.5 CONDUIT BOXES

- .1 Cast FS Aluminum boxes with factory-threaded hubs and mounting feet for surface wiring of switches and receptacles.
- .2 Metal type "FS" device plates to be used on all type "FS" boxes unless noted otherwise.

## 2.6 FLOOR BOXES

- .1 Not Applicable.

## 2.7 RIGID CONDUIT BOXES

- .1 Not Applicable.

## 2.8 MULTI-OUTLET BOXES

- .1 Electro-galvanized steel barrier pre-ganged **multi-outlet boxes** for devices with different sources of voltage in the same box.
- .2 The barrier of sheet steel shall not be less than (No. 16 MSG) thick used to divide the space into separate compartments for the conductors of each system. The barrier shall be fastened rigidly to the box.

## 2.9 FITTINGS - GENERAL

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

## 2.10 CONDUIT SUPPORTS

- .1 In steel stud framing construction provide for boxes a metal stud clip (Caddy MSF) and a far side support (Caddy 766) or a separate quick mount support (Caddy "H" Series).
- .2 Use adjustable screws gun brackets (caddy "TS" series) where box requires mounting between steel studs.
- .3 Other support system will be accepted only after review by Departmental Representative.

## Part 3 - Execution

### 3.1 INSTALLATION

- .1 Support boxes independently of connecting conduits.
- .2 Fill boxes with paper, sponges or foam or similar approved material to prevent entry of construction material.
- .3 For flush installations mount outlets flush with finished wall using plaster rings to permit wall finish to come within 65mm of opening.
- .4 Provide correct size of openings in boxes for conduit and armoured cable connections. Reducing washers not allowed.

- .5 At each local switch, receptacle, ceiling or wall fixture, continuous row of fixtures, or system unit (i.e. fire alarm, T.V., etc.) provide and install a standard or twin filler or barrier pressed steel outlet box, unless specifically noted otherwise. All outlet boxes shall be fabricated of galvanized sheet steel and set flush with finished surfaces. They shall be rigidly and securely set.
- .6 All flexible conduit fixture feeds shall originate from the side of the outlet box and not from the box cover.
- .7 In locating outlets, take care to allow for radiation, pipes, ducts, etc., and for the variation in arrangement and thickness of finishes, etc. Failure to comply with this will not relieve Division 16 Contractor from the cost of necessary alterations.
- .8 Allow for the relocation of an outlet up to a dimension of 3m from that indicated on drawings, provided notice is given before roughing-in has been completed.
- .9 Install floor boxes in concrete formwork, prior to concrete pour, securely set to ensure finished collar is flush with the surface of the specified finish flooring.

**-- END OF SECTION --**

**Part 1 – General****1.1 REFERENCE STANDARDS**

- .1 Canadian Standards Association (CSA)
  - .1 CAN/CSA C22.2 No. 18, Outlet Boxes, Conduit Boxes, and Fittings and Associated Hardware.
  - .2 CSA C22.2 No. 45, Rigid Metal Conduit.
  - .3 CSA C22.2 No. 56, Flexible Metal Conduit and Liquid-Tight Flexible Metal Conduit.
  - .4 CSA C22.2 No. 83, Electrical Metallic Tubing.
  - .5 CSA C22.2 No. 211, Rigid PVC (Unplasticized) Conduit.
  - .6 CAN/CSA C22.2 No 227, Flexible Nonmetallic Tubing.

**1.2 WASTE MANAGEMENT AND DISPOSAL**

- .1 Separate and recycle waste materials in accordance with local requirements.
- .2 Place materials defined as hazardous or toxic waste in designated containers.
- .3 Ensure emptied containers are sealed and stored safely for disposal away from children.
- .4 Collect and separate plastic, paper packaging and corrugated cardboard in accordance with Waste Management Plan.

**Part 2 - Products****2.1 CONDUITS**

- .1 Rigid metal conduit: to CSA C22.2 No. 45, galvanized steel threaded, size as indicated.
- .2 Thin wall type electrical metallic tubing "EMT" with steel set screw couplings, galvanized, size as indicated.
- .3 Rigid PVC conduit, size as indicated.

**2.2 EXPANSION FITTINGS FOR RIGID CONDUIT**

- .1 Weatherproof expansion fittings with internal bonding assembly suitable for 100 mm linear expansion.
- .2 Watertight expansion fittings with integral bonding jumper suitable for linear expansion and 19 mm deflection in all directions.
- .3 Weatherproof expansion fittings for linear expansion at entry to panel.

**2.3 FISHCORD**

- .1 6.5 mm standard nylon pull rope with tensile strength of 5 kN.

**Part 3 - Execution**

**3.1 INSTALLATION**

- .1 All Interior wiring must be installed in EMT. Use rigid PVC conduit underground and in corrosive areas.
- .2 Minimum conduit size for lighting and power circuits: 19 mm.
- .3 Install fish cord in empty conduits.
- .4 Dry conduits out before installing wire.

**3.2 CONDUITS UNDERGROUND**

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

**-- END OF SECTION --**

**Part 1 General****1.1 RELATED REQUIREMENTS**

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

**1.2 REFERENCE STANDARDS**

- .1 CSA Group (CSA)
  - .1 CAN/CSA-Z809-08, Sustainable Forest Management.
- .2 Forest Stewardship Council (FSC)
  - .1 FSC-STD-01-001-2004, FSC Principle and Criteria for Forest Stewardship.
- .3 Insulated Cable Engineers Association, Inc. (ICEA)

**1.3 ACTION AND INFORMATIONAL SUBMITTALS**

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

**1.4 DELIVERY, STORAGE AND HANDLING**

- .1 Deliver, store and handle materials 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 cables from nicks, scratches, and blemishes.
  - .3 Replace defective or damaged materials with new.
- .4 Develop Construction Waste Management Plan related to Work of this Section.
- .5 Packaging Waste Management: Section 01 74 19 - Waste Management and Disposal.

**Part 2 Products****2.1 CABLE PROTECTION**

- .1 38 x 140 mm planks pressure treated with clear or coloured.

**2.2 MARKERS**

- .1 Concrete type cable markers: 600 x 600 x 100 mm with words: cable, joint or conduit impressed in top surface, with arrows to indicate change in direction of cable and duct runs.

- .2 Cedar post type markers: to CAN/CSA-Z809
  - .1 Nameplate: aluminum anodized 89 x 125mm, 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.

### **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 cable installation in accordance with manufacturer's written instructions.
  - .1 Visually inspect substrate in presence of Representative.
  - .2 Inform Representative of unacceptable conditions immediately upon discovery.
  - .3 Proceed with installation only after unacceptable conditions have been remedied.

#### **3.2 DIRECT BURIAL OF CABLES**

- .1 After sand bed is in place, lay cables maintaining 75 mm clearance from each side of trench to nearest cable.
  - .1 Do not pull cable into trench.
- .2 Include offsets for thermal action and minor earth movements.
  - .1 Offset cables 150 mm minimum for each 60 m run, maintaining minimum cable separation and bending radius requirements.
- .3 Make termination and splice only as indicated leaving 0.6 m minimum of surplus cable in each direction.
  - .1 Make splices and terminations in accordance with manufacturer's written recommendations using approved splicing kits.
- .4 Underground cable splices not acceptable.
- .5 Minimum permitted radius at cable bends for rubber, plastic or lead covered cables, 8 times diameter of cable or in accordance with manufacturer's written recommendations; for metallic armoured cables, 12 times diameter of cables or in accordance with manufacturer's instructions.
- .6 Cable separation:
  - .1 Maintain 75 mm minimum separation between cables of different circuits.
  - .2 Maintain 300 mm minimum horizontal separation between low and high voltage cables.
  - .3 When low voltage cables cross high voltage cables maintain 300 mm vertical separation with low voltage cables in upper position.
  - .4 At crossover, maintain 75 mm minimum vertical separation between low voltage cables and 150 mm between high voltage cables.
  - .5 Maintain 300 mm minimum lateral and vertical separation for fire alarm and control cables when crossing other cables, with fire alarm and control cables in upper position.

- .6 Install treated planks on lower cables 0.6 m minimum in each direction at crossings.
- .7 After sand protective cover is in place, install continuous row of 38 x 140mm pressure treated planks as indicated to cover length of run.

### 3.3 CABLE INSTALLATION IN DUCTS

- .1 Install cables as indicated in ducts.
- .2 Do not pull spliced cables inside ducts.
- .3 Install multiple cables in duct simultaneously.
- .4 Use CSA approved lubricants of type compatible with cable jacket to reduce pulling tension.
- .5 To facilitate matching of colour coded multiconductor control cables reel off in same direction during installation.
- .6 Before pulling cable into ducts and until cables are properly terminated, seal ends of lead covered cables with wiping solder; seal ends of non-leaded cables with moisture seal tape.
- .7 After installation of cables, seal duct ends with duct sealing compound.

### 3.4 MARKERS

- .1 Mark cable every 150 m along cable or duct runs and changes in direction.
- .2 Mark underground splices.
- .3 Where markers are removed to permit installation of additional cables, reinstall existing markers.
- .4 Install concrete cable markers within 180 m from each side of runway centreline; 45 m from each side of taxi way centreline; 50 m from edge of taxi ramps or aprons.
- .5 Install cedar post type markers.
- .6 Lay concrete markers flat and centred over cable with top flush with finish grade.

### 3.5 FIELD QUALITY CONTROL

- .1 Perform tests in accordance with Section 26 05 00 - Common Work Results for Electrical.
- .2 Perform tests using qualified personnel.
  - .1 Include necessary instruments and equipment.
- .3 Check phase rotation and identify each phase conductor of each feeder.
- .4 Check each feeder for continuity, short circuits and grounds.
  - .1 Ensure resistance to ground of circuits is not less than 50 megohms.



- .5 Pre-acceptance tests:
  - .1 After installing cable but before splicing and terminating, perform insulation resistance test with 1000 V megger on each phase conductor.
  - .2 Check insulation resistance after each splice and/or termination to ensure that cable system is ready for acceptance testing.
- .6 Acceptance Tests:
  - .1 Ensure that terminations and accessory equipment are disconnected.
  - .2 Ground shields, ground wires, metallic armour and conductors not under test.
  - .3 High Potential (Hipot) Testing.
    - .1 Conduct Hipot testing at manufacturer's recommendations.
  - .4 Leakage Current Testing:
    - .1 Raise voltage in steps from zero to maximum values as specified by manufacturer for type of cable being tested.
    - .2 Hold maximum voltage for specified time period by manufacturer.
    - .3 Record leakage current at each step.
  - .7 Provide Representative with list of test results showing location at which each test was made, circuit tested and result of each test.
  - .8 Remove and replace entire length of cable if cable fails to meet any of test criteria.

### **3.6 CLEANING**

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

### **3.7 PROTECTION**

- .1 Repair damage to adjacent materials caused by cables installation.

**-- END OF SECTION --**

**Part 1 General****1.1 RELATED REQUIREMENTS**

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

**1.2 REFERENCE STANDARDS**

- .1 CSA Group (CSA)
  - .1 CSA C22.2 No.29, Panelboards and Enclosed Panelboards.

**1.3 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
  - .1 Submit manufacturer's instructions, printed product literature and data sheets for panelboards and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Shop Drawings:
  - .1 Submit drawings stamped and signed by professional engineer registered or licensed in Province of Nova Scotia, Canada.
  - .2 Include on drawings:
    - .1 Electrical detail of panel, branch breaker type, quantity, ampacity and enclosure dimension.

**1.4 CLOSEOUT SUBMITTALS**

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

**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 in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
  - .2 Store and protect panelboards from nicks, scratches, and blemishes.
  - .3 Replace defective or damaged materials with new.
- .4 Packaging Waste Management: remove for reuse in accordance with Section 01 74 19 - Waste Management and Disposal.

**Part 2 Products****2.1 PANELBOARDS**

- .1 Panelboards: to CSA C22.2 No.29 and product of one manufacturer.
  - .1 Install circuit breakers in panelboards before shipment.
  - .2 In addition to CSA requirements, manufacturer's nameplate must show fault current that panel including breakers has been built to withstand.
- .2 600 or 250V panelboards: bus and breakers rated as specified
- .3 Sequence phase bussing with odd numbered breakers on left and even on right, with each breaker identified by permanent number identification as to circuit number and phase.
- .4 Panelboards: mains, number of circuits, and number and size of branch circuit breakers as indicated.
- .5 Minimum of 2 flush locks for each panel board.
- .6 Two keys for each panelboard and key panelboards alike.
- .7 Copper bus with neutral of double ampere rating of mains.
- .8 Mains: suitable for bolt-on breakers.
- .9 Trim with concealed front bolts and hinges.
- .10 Trim and door finish: air dried enamel as per colour schedule.
- .11 Isolated ground bus.
- .12 Include grounding busbar with 3 of terminals for bonding conductor equal to breaker capacity of the panel board.

**2.2 BREAKERS**

- .1 Breakers: to Section 26 28 16.02 - Moulded Case Circuit Breakers.
- .2 Breakers with thermal and magnetic tripping in panelboards except as indicated otherwise.
- .3 Main breaker: separately mounted on top or bottom of panel to suit cable entry. When mounted vertically, down position should open breaker.
- .4 Lock-on devices for 10% of 15 to 30 A breakers installed as indicated. Turn over unused lock-on devices to Representative.
- .5 Lock-on devices for fire alarm, emergency, door supervisory, exit and night light circuits.

**2.3 EQUIPMENT IDENTIFICATION**

- .1 Provide equipment identification in accordance with Section 26 05 00- Common Work Results for Electrical.
- .2 Nameplate for each panelboard size 4 engraved as indicated.
- .3 Nameplate for each circuit in distribution panelboards size 2 engraved as indicated.

- .4 Complete circuit directory with typewritten legend showing location and load of each circuit, mounted in plastic envelope at inside of panel door.
- .5 Circuits supplying Patient Care Areas must be entered in circuit directory with **bold font**.

### **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 panelboards installation in accordance with manufacturer's written instructions.

#### **3.2 INSTALLATION**

- .1 Locate panelboards as indicated and mount securely, plumb, true and square, to adjoining surfaces.
- .2 Install surface mounted panelboards on plywood backboards. Where practical, group panelboards on common backboard.
- .3 Mount panelboards to height specified in Section 26 05 00- Common Work Results for Electrical or as indicated.
- .4 Connect loads to circuits.
- .5 Connect neutral conductors to common neutral bus with respective neutral identified.
- .6 Where panels of different systems, ground busses in panels to be interconnect with a minimum #6 AWG ground conductor.

#### **3.3 CLEANING**

- .1 Progress Cleaning: clean in accordance with Section 01 74 00 - Cleaning.
  - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 00 - Cleaning.
- .3 Waste Management: separate waste materials in accordance with Section 01 74 19 - Waste Management and Disposal.
  - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

#### **3.4 PROTECTION**

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

**-- END OF SECTION --**

**Part 1 – General****1.1 REFERENCE STANDARDS**

- .1 CSA C22.2 No. 111 – General Use Switches.
- .2 CSA C22.2 No. 42 – General Use Receptacles, Attachment Plugs and Similar Wiring Devices.

**1.2 RELATED WORK**

- .1 Not Applicable.

**1.3 SHOP DRAWINGS AND PRODUCT DATA**

- .1 Submit shop drawings and product data in accordance with Division 1.

**1.4 OPERATION AND MAINTENANCE DATA**

- .1 Not Applicable

**Part 2 - Products****2.1 SWITCHES**

- .1 Not Applicable

**2.2 RECEPTACLES**

- .1 Unless specified otherwise, duplex receptacles, CSA Type as indicated, on drawings.

**2.3 EXTERIOR RECEPTACLES**

- .1 Duplex receptacles GFCI, weatherproof with lid CSA Type as indicated, on drawings.

**2.4 COVER PLATES**

- .1 As noted on the drawings.

**2.5 INDUSTRIAL DUTY CABLE REEL**

- .1 Not Applicable.

**2.6 MANUFACTURERS**

- .1 Standard of Acceptance: Hubbell, Leviton, Watt Stopper.

**Part 3 - Execution****3.1 INSTALLATION**

- .1 Switches:
  - .1 Not Applicable.
- .2 Receptacles:
  - .1 Not Applicable.
- .3 Cover Plates:
  - .1 Not Applicable.
- .4 Exterior Receptacles:
  - .1 As specified.
- .5 Industrial Cord Reel:
  - .1 Not Applicable.

**-- END OF SECTION --**

**Part 1 - General****1.1 REFERENCE STANDARDS**

- .1 CSA C22.2 No. 5.1 - Moulded Case Circuit Breakers.

**1.2 RELATED WORK**

- .1 Not Applicable

**1.3 SHOP DRAWINGS AND PRODUCT DATA**

- .1 Submit product data in accordance with Division 1.
- .2 Include time-current characteristic curves for breakers with ampacity of 400A and over or with interrupting capacity of 22,000A symmetrical rms and over at system voltage.

**1.4 OPERATION AND MAINTENANCE DATA**

- .1 Not Applicable

**Part 2 - Products****2.1 BREAKERS GENERAL**

- .1 Bolt on moulded case circuit breaker, quick-make, quick-break type, de-ionizing arc chambers for manual and automatic operation with temperature compensation for 40°C ambient. Breakers to be trip free of operating handles on overloads with a definite indication when tripping has taken place.
- .2 Multi-pole breakers shall have common trip mechanisms; tie handles will not be acceptable.
- .3 Magnetic instantaneous trip elements in circuit breakers, to operate only when the value of current reaches setting. Trip settings on breakers with adjustable trips to range from 10 to 12 times current rating.
- .4 Circuit breakers with interchangeable trips as indicated.
- .5 Minimum acceptable circuit breaker interrupting rating shall be 14,000 RMS symmetrical amperes or as indicated on the drawings.

**2.2 MANUFACTURERS**

- .1 Standard of Acceptance: Federal Pioneer.
- .2 Other approved manufacturers: Cutler – Hammer, Square D.

**Part 3 - Execution****3.1 INSTALLATION**

- .1 Circuit breakers shall be securely mounted in switchboards, panelboards, or EEMAC one (1) enclosures as indicated on the drawings and as required by other sections of the specifications.

### 3.2 SUBMITTALS

- .1 Prior to any installation of circuit breakers in either a new or existing installation, Contractor must submit three (3) copies of a certificate of origin, from the manufacturer, duly signed by the factory and the local manufacturer's representative, certifying that all circuit breakers come from this manufacturer, they are new and they meet standards and regulations. These certificates must be submitted to the Departmental Representative for approval.
- .2 A delay in the production of the certificate of origin won't justify any extension of the contract and additional compensation.
- .3 Any work of manufacturing, assembly or installation should begin only after acceptance of the certificate of origin by Departmental Representative. Unless complying with this requirement, Departmental Representative reserves the right to mandate the manufacturer listed on circuit breakers to authenticate all new circuit breakers under the contract, and that, to Contractor's expense.
- .4 In general, the certificate of origin must contain:
  - .1 The name and address of the manufacturer and the person responsible for authentication. The responsible person must sign and date the certificate;
  - .2 The name and address of the licensed dealer and the person of the distributor responsible for the Contractor's account.
  - .3 The name and address of the Contractor and the person responsible for the project.
  - .4 The name and address of the local manufacturer's representative. The local representative must sign and date the certificate.
  - .5 The name and address of the building where circuit breakers will be installed:
    - .1 Project title.
    - .2 End user's reference number.
    - .3 The list of circuit breakers.

-- END OF SECTION --



**Part 1 – General****1.1 RELATED REQUIREMENTS**

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

**1.2 REFERENCE STANDARDS**

- .1 American Petroleum Institute (API)
  - .1 API Std. 650-A2008, Welded Steel Tanks for Oil Storage 11th Edition.
- .2 Canadian General Standards Board (CGSB)
  - .1 CAN/CGSB-3.6-2000, Amend. 2, Regular Sulphur Diesel Fuel.
- .3 Canadian Environmental Protection Act (CEPA)
  - .1 CCME PN 1326-2008, Environmental Code of Practice for Aboveground and Underground Storage Tank Systems for Petroleum Products and Allied Petroleum Products.
- .4 CSA Group (CSA)
  - .1 CSA-B139-15, Installation Code for Oil Burning Equipment.
- .5 International Organization for Standardization (ISO)
  - .1 ISO 3046-1-2002, Reciprocating Internal Combustion Engines - Performance - Part 1: Declarations of Power, Fuel and Lubricating Oil Consumptions, and Test Methods - Additional requirements for engines for general use.
- .6 National Electrical Manufacturers Association (NEMA)
  - .1 NEMA MG 1-R2007, Motors and Generators.
- .7 Underwriters' Laboratories of Canada (ULC)
  - .1 CAN/ULC-S601-07, Standard for Shop Fabricated Steel Aboveground Horizontal Tanks for Flammable and Combustible Liquids.
  - .2 ULC-S603-00, Standard for Steel Underground Tanks for Flammable and Combustible Liquids.

**1.3 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Submit submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
  - .1 Provide manufacturer's printed product literature, specifications and data sheets for power generators and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Shop Drawings:
  - .1 Submit drawings stamped and signed by professional engineer registered in NS province and include:
    - .1 Engine: make and model, with performance curves.
    - .2 Alternator: make and model.
    - .3 Voltage regulator: make, model and type.

- .4 Automatic transfer switch: make, model and type.
- .5 Manual bypass switch: make and model.
- .6 Battery: make, type and capacity.
- .7 Battery charger: make, type and model.
- .8 Alternator control panel: make and type of meters and controls.
- .9 Governor type and model.
- .10 Automatic engine room ventilation system.
- .11 Cooling air requirements in m<sup>3</sup>/s.
- .12 British standard or DIN rating of engine.
- .13 Flow diagrams for:
  - .1 Diesel fuel.
  - .2 Cooling air.
- .14 Dimensioned drawing showing complete generating set mounted on steel base, including vibration isolators, exhaust system, drip trays, and total weight.
- .15 Continuous full load output of set at 0.8 PF lagging.
- .16 Description of set operation including:
  - .1 Automatic starting and transfer to load and back to normal power, including time in seconds from start of cranking until unit reaches rated voltage and frequency.
  - .2 Manual starting.
  - .3 Automatic shut down and alarm on:
    - .1 Overcranking.
    - .2 Overspeed.
    - .3 High engine temp.
    - .4 Low lube oil pressure.
    - .5 Short circuit.
    - .6 Alternator over voltage.
    - .7 Lube oil high temperature.
    - .8 Over temperature on alternator.
  - .4 Manual remote stand-by stop.

#### 1.4 CLOSEOUT SUBMITTALS

- .1 Provide operation and maintenance data for diesel generator for incorporation into manual specified in Section 01 78 00 – Close-out Submittals.
- .2 Include in Operation and Maintenance Manual instructions for the particular unit supplied and not general description of units manufactured by supplier and:
  - .1 Operation and maintenance instructions for engine, alternator, control panel, automatic transfer switch, manual bypass switch, battery charger, battery, fuel system, engine room ventilation system, exhaust system and accessories, to permit effective operation, maintenance and repair.
  - .2 Technical data:

- .1 Illustrated parts lists with parts catalogue numbers.
- .2 Schematic diagram of electrical controls.
- .3 Flow diagrams for:
  - .1 Fuel system.
  - .2 Lubricating oil.
  - .3 Cooling system.
- .4 Certified copy of factory test results.
- .5 Maintenance and overhaul instructions and schedules.
- .6 Precise details for adjustment and setting of time delay relays or sensing controls which require on site adjustment.

## **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 Packaging Waste Management: remove for reuse in accordance with Section 01 74 19 - Waste Management and Disposal.

## **1.6 MAINTENANCE MATERIAL SUBMITTALS**

- .1 Provide maintenance materials in accordance with Section 01 78 00 – Close-out Submittals.
- .2 Include:
  - .1 2 fuel filter replacement elements.
  - .2 2 lube oil filter replacement elements.
  - .3 2 air cleaner filter elements.
  - .4 2 sets of fuses for control panel.
  - .5 Special tools for unit servicing.
  - .6 Onsite spill kit.

## **Part 2 – Products**

### **2.1 SYSTEM DESCRIPTION**

- .1 Generating system consists of:
  - .1 Diesel engine.
  - .2 Alternator.
  - .3 Alternator control panel.
  - .4 Automatic transfer equipment.
  - .5 Battery charger and battery.
  - .6 Automatic engine room ventilation system.
  - .7 Fuel supply system.

- .8 Exhaust system.
  - .9 Steel mounting base.
  - .10 Synchronizing panel.
  - .11 Manual by-pass switch.
- .2 System designed to operate as standby.

## 2.2 DIESEL ENGINE

- .1 Diesel engine: to ISO 3046-1.
- .2 Factory-assembled and -tested, engine-generator set. The generator set shall be capable of a 130°C Standby rating while operating in an ambient condition of less than or equal to 77°F and a maximum elevation of 500 ft above sea level. The standby rating shall be available for the duration of the outage. The generators shall have a load bank test connection for maintenance tests.
- .3 Three generators shall be as below:
- North River lagoon UV building: Generator shall provide 23 kW/23 kVA when operating at 120/240VAC volts, 1 phase, 60 Hz, 0.80 power factor.
- Warren Grove lift station: Generator shall provide 30 kW/37.5 kVA when operating at 120/208VAC volts, 3 phase, 60 Hz, 0.80 power factor.
- River Point Water station: Generator shall provide 23 kW/23 kVA when operating at 120/240VAC volts, 1 phase, 60 Hz, 0.80 power factor.
- .4 Synchronous speed 1800 rpm.
- .5 Capacity:
- .1 Rated continuous power at rated speed, after adjustment for system losses in auxiliary equipment necessary for engine operation; to be calculated as follows:  
Rated continuous output = Generator kW divided by Generator efficiency at full load.
  - .2 Engine overload capability 110% of continuous output for 1 hour within 12 hours period of continuous operation.
- .6 Cooling System:
- .1 Liquid cooled: heavy duty industrial radiator mounted on generating set base with engine driven pusher type fan to direct air through radiator from engine side, with ethylene glycol anti-freeze non-sludging above -46 degrees C.
  - .2 Air cooled: air cooling duct enveloping cylinder walls with pressure cooling by engine driven blower.
  - .3 To maintain manufacturer's recommended engine temperature range at 10% continuous overload in ambient temperature of 40 degrees C.
  - .4 Block heater: thermostatically controlled lube oil or liquid coolant heater connected to line side of automatic transfer switch to allow engine to start in room ambient 0 degrees C.
    - .1 Switch and fuse in heater circuit, mounted in engine-alternator control cubicle and fed from line side of automatic transfer switch.

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- .7 Fuel: to CAN/CGSB-3.6, Type A, Arctic Grade 1.
  - .8 Fuel system: solid injection, mechanical fuel transfer pump with hand primer, fuel filters and air cleaner, fuel rack solenoid energized when engine running.
    - .9 Governor: mechanical hydraulic with:
      - .1 Steady state speed band of plus or minus 0.5%.
      - .2 Speed regulation no load to full load 5% maximum.
      - .3 Electronic load sharing type, electric actuator, speed droop externally adjustable from isochronous to 5%, temperature compensated with steady state speed maintenance capability of plus or minus 0.25%.
  - .10 Lubrication system:
    - .1 Pressure lubricated by engine driven pump.
    - .2 Lube oil filter: replaceable, full flow type, removable without disconnecting piping.
    - .3 Lube oil cooler.
    - .4 Engine sump drain valve.
    - .5 Oil level dipstick.
  - .11 Starting system:
    - .1 Positive shift, gear engaging starter 12 or 24V dc.
    - .2 Cranking limiter to provide trois (3) cranking periods of 10s duration, each separated by 5 s rest.
    - .3 Lead acid, 12 or 24V storage battery with sufficient capacity to crank engine for 1 min at 0 degrees C without using more than 25% of ampere hour capacity.
    - .4 Battery charger: constant voltage, solid state, two stage from trickle charge at standby to boost charge after use.
      - .1 Regulation: plus or minus 1% output for plus or minus 10% input variation.
      - .2 Automatic boost for 6 hours every 30 days.
      - .3 Equipped with dc voltmeter, dc ammeter and on-off switch.
      - .4 Minimum charger capacity: 7 A.
  - .12 Vibration isolated engine instrument panel with:
    - .1 Lube oil pressure gauge.
    - .2 Lube oil temperature gauge.
    - .3 Lube oil level gauge.
    - .4 Coolant temperature gauge.
    - .5 Coolant level gauge.
    - .6 Running time meter: non-tamper type.
  - .13 Guards to protect personnel from hot and moving parts.
    - .1 Locate guards so that normal daily maintenance inspections can be undertaken without their removal.

.14 Drip tray.

## 2.3 ALTERNATOR

.1 Alternator: to NEMA MG1.

.2 Rating: 3 phase

.3 Output at 40 degrees C ambient:

.1 100% full load continuously.

.2 110% full load for 1 hour.

.3 150% full load for 1 minute.

.4 Revolving field, brushless, single bearing.

.5 Drip proof.

.6 Amortisseur windings.

.7 Synchronous type.

.8 Dynamically balanced rotor permanently aligned to engine by flexible disc coupling.

.9 Exciter: rotating brushless.

.10 NEMA class H insulation on windings.

.11 Thermistors or Platinum resistance temperature transducers embedded in stator winding and connected to alternator control circuitry.

.12 Voltage regulator: thyristor controlled rectifiers with phase controlled sensing circuit:

.13 Alternator: capable of sustaining 300% rated current for period not less than 10 s permitting selective tripping of down line protective devices when short circuit occurs.

## 2.4 WEATHER ENCLOSURE (HOUSING)

.1 Enclosure to meet CSA C282-15, complete with automatic louvers and space heaters.

.2 Enclosure to contain stand-by lighting with 2-hour run time.

.3 Enclosure to contain a 125V-20A NEMA 5-20R receptacle.

.4 Distribution panel/load center for connects to block heater, battery charger, stand-by lighting, and enclosure heater.

.5 Internal silencer, flexible exhaust connector and rain cap.

.6 Level 1 sound reduction using acoustic insulation, 75 dBA at 7 metres.

.7 Secured to generator and skid.

.8 Fabricated of aluminum or steel with hinged and removable doors to allow for easy maintenance. Doors shall have a means to be secured in the open position for servicing by a latching mechanism.

.9 Lockable, flush-mounted door latches.

.10 Reduced rain entry air inlet louvers.

.11 Rodent guards with skid end caps.

.12 Acoustic insulation material shall meet UL 94 HF1 flammability classification.

- .13 Factory painted with face, scratch and corrosion resistant automotive grade finish.

## 2.5 CONTROL PANEL

- .1 Instruments:
  - .1 Digital indicating type 2 % accuracy, rectangular face, flush panel mounting:
    - .1 Voltmeter: ac, scale 0 to system voltage
    - .2 Ammeter: ac, scale 0 to system current
    - .3 Wattmeter scale 0 to system power
    - .4 Frequency meter: scale 55 to 65Hz.
    - .5 kVAR meter and kWh metre.
  - .2 Voltmeter selector switch, rotary, panel mounting, four position, labelled "Off-Phase A-Phase B-Phase C".
  - .3 Ammeter selector switch, rotary, maintained contacts, panel mounting, designed to prevent opening of current circuits, four position, labelled "Off-Phase A-Phase B-Phase C". Instrument Transformers:
    - .1 Potential-dry type for indoor use
    - .2 Current-dry type for indoor use

## 2.6 REMOTE ANNUNCIATOR PANEL

- .1 Supplied with the following features:
  - .1 Alarm horn, giving a minimum 90 dB at 0.1 m audible alarm when a warning or shutdown fault condition exists. Alarm silence switch.
  - .2 Stand-by stop switch.
  - .3 ATS fault indication when ATS fails to transfer.
  - .4 Battery charger fail LED indicator/alarm.
  - .5 Generator supplying load LED indicator/alarm.
  - .6 High engine temperature LED indicator/alarm.
  - .7 Low fuel level LED indicator/alarm.
  - .8 Low oil pressure LED indicator/alarm.
  - .9 Overcrank LED indicator/alarm.
  - .10 Fuel leak detected LED indicator/alarm.

## 2.7 CONTROLS

- .1 Engine start button.
- .2 Selector switch: Off-Auto-Manual - Test full load test and no load.
- .3 Engine stand-by stop button and provision for remote stand-by stop button.
  - .1 Alternator output breaker:
    - .1 Circuit breaker: bolt-on, moulded case, temperature compensated for 40 degrees C ambient, dual thermal-magnetic trip.
    - .2 Circuit breaker, solid state sensing with:

- .1 Frame containing breaker contacts, arc quenchers, quick-make, quick-break, spring-loaded over center switching mechanism, mechanically trip free from handle, fixed type.
- .2 Static sensor: current monitors detect overload, short-circuit and ground-fault currents, and send these signals through solid-state circuits to static sensor which acts to trip breaker. Adjustable for current values and time of tripping.
- .3 Flux-transfer shunt trip - magnetic tripping device actuated by signal from static sensor to open breaker contacts. Requires no external source of power.
- .2 Voltage control rheostat: mounted on inside of control panel.
- .3 Operating lights, panel mounted:
  - .1 "Normal power" pilot light.
  - .2 "Stand-by power" pilot light.
  - .3 Green pilot lights for breaker on and red pilot lights for breaker off.
- .4 Solid state indicator lights for alarm with 1 set manually reset NO/NC contacts wired to terminal block for remote annunciation on:
  - .1 Low fuel level.
  - .2 Low battery voltage.
  - .3 Ventilation failure.
  - .4 Low coolant temperature.
- .5 Solid state controller for automatic shutdown and alarms with 1 set manually reset NO/NC contacts wired to terminal block for remote annunciation on:
  - .1 Engine overcrank.
  - .2 Engine overspeed.
  - .3 Engine high temperature.
  - .4 Engine low lube oil pressure.
  - .5 Short circuit.
  - .6 AC over voltage.
- .6 Lamp test button.
- .7 Synchronization and load sharing.
- .8 Provision for remote monitoring.

## **2.8 AUTOMATIC TRANSFER SWITCH**

- .1 Section 26 36 23

## **2.9 MANUAL BYPASS SWITCH**

- .1 Load break bypass and isolation switch: manually operated, double throw, to provide bypass around transfer switch to facilitate maintenance on diesel generator control panel and transfer switch. Switch lockable in bypass position.



**2.10 STEEL MOUNTING BASE**

- .1 Complete generating set mounted on structural steel base of sufficient strength and rigidity to protect assembly from stress or strain during transportation, installation and under operating conditions on suitable level surface.
- .2 Assembly fitted with vibration isolators and control console resiliently mounted.
  - .1 Spring type isolators with adjustable side snubbers and adjustable for levelling.
- .3 Sound insulation pads for installation between isolators and concrete base.

**2.11 EXHAUST SYSTEM**

- .1 Heavy duty critical mounted exhaust silencer with condensate drain, plug and welded couplings.
- .2 Heavy duty flexible exhaust pipe with flanged couplings as required.
- .3 Fittings and accessories as required.
- .4 Expansion joints: stainless steel, corrugated, of suitable length, to absorb both vertical and horizontal expansion.

**2.12 FUEL SYSTEM**

- .1 Fuel storage tanks: to API Standard 650, ULC labelled.
  - .1 Above ground tank: to ULC-S601.
  - .2 Underground tank: to ULC-S603.
- .1 Aboveground fuel storage tank: Double Wall Secondary Containment Sub-base Fuel Tank
- .2 The generator set shall be supplied with a sub-base fuel tank of sufficient capacity to hold diesel fuel for 24 hours capacity at full load and not exceed 2500L capacity. The state tank shall have 5 Gal fuel lockable spill containment and a above grade vent extensions
- .3 Underground fuel storage tank: Not applicable
  - .1 Electrically operated fuel transfer pump with float switch.
- .4 Fuel level gauge and vent alarm.
- .5 Emergency vent pipe must terminate outside the enclosure as per CSA B139.
- .6 Generator must be compliant with B139 Code for Oil Burning Equipment Series 19
- .7 Fuel storage tank must be properly labelled, using the Canadian Fuels Colour-Symbol System to Mark Equipment and Vehicles for Product Identification
- .8 Drain and end plug.
- .9 Copper feed and return lines, with flexible terminations at engine.
- .10 Shut-off cock.
- .11 Renewable cartridge filter.
- .12 Fire valve.

- .13 Isolating valves on lines serving auxiliaries.
- .14 Low fuel level alarm for remote indication.

## **2.13 COOLING AIR SYSTEM**

- .1 Engine ventilating system:
  - .1 Recirculating damper assembly with modulating motor.
  - .2 Cold air inlet damper assembly with modulating motor.
  - .3 Air discharge and intake gooseneck weatherhoods.
  - .4 Modulating thermostat.
  - .5 Replaceable air intake filters.

## **2.14 EQUIPMENT IDENTIFICATION**

- .1 Provide equipment identification in accordance with Section 26 05 00 - Common Work Results for Electrical.

## **2.15 FABRICATION**

- .1 Shop assemble generating unit including:
  - .1 Base.
  - .2 Engine and radiator.
  - .3 Alternator.
  - .4 Control panel.
  - .5 Battery and charger.
  - .6 Automatic transfer equipment.

## **2.16 FINISHES**

- .1 Apply finishes in accordance with Section 26 05 00 - Common Work Results for Electrical.
- .2 Alternator control cubicle: paint inside, exterior to match engine and alternator.
- .3 Exhaust and inlet air hoods.
- .4 Other ducts and racks grey.
- .5 Supply 0.25 L of grey touch-up enamel.

## **2.17 SOURCE QUALITY CONTROL**

- .1 Factory test generator set including engine, alternator, control panels, transfer switch and accessories in presence of Representative. Provide factory test report as part of startup documentation.
- .2 Notify Representative 10 days in advance of date of factory test.
- .3 Test procedure:
  - .1 Prepare blank forms and check sheet with spaces to record data and at top of first sheet record:

- .1 Date.
- .2 Generator set serial no.
- .3 Engine, make, model, serial no.
- .4 Alternator, make, model, serial no.
- .5 Voltage regulator, make and model.
- .6 Rating of generator set, kW, kV.A, V, A, r/min, Hz.
- .2 Mark check sheet and record data on forms in duplicate as test proceeds.
- .3 Representative's signature on completed forms to indicate concurrence in results of test.
- .4 Tests: As per CSA C282-15
  - .1 Provide fuel for testing and leave full tanks on acceptance.  
Demonstrate:
    - .1 Unit start, transfer to load, retransfer to normal power, unit shut down, on "Automatic" control.
    - .2 Unit start and shut down on "Manual" control.
    - .3 Unit start and transfer on "Test" control.
    - .4 Unit start on "Engine start" control.
    - .5 Operation of automatic alarms and shut down devices.Run unit on normal building load for a period of 1 hour. Follow with a period of 4 hours of full load bank test to show load carrying ability, stability of voltage and frequency, and satisfactory performance of ventilating system to provide adequate engine cooling.  
Perform crank test.
    - .1 Provide a cranking cycle consisting of 30 seconds of continuous cranking or three (3) 10-second crank attempts separated by 10-second rest periods.
    - .2 Repeat a second time to demonstrate that the batteries have sufficient capacity for a total cranking time of 60 seconds.At end of test run, check battery voltage to demonstrate battery charger has returned battery to fully charged state.  
Monitor parameters:
    - .1 Ambient temp in degrees C.
    - .2 Lube oil pressure in kPa.
    - .3 Lube oil temp in degrees C.
    - .4 Engine coolant temp in degrees C.
    - .5 Exhaust stack temp in degrees C.
    - .6 Alternator voltage: phase 1, 2, 3.
    - .7 Alternator current: phase 1, 2, 3.
    - .8 Power in kW.
    - .9 Frequency in Hz.
    - .10 Power Factor.
    - .11 Battery charger current in A.

- .12 Battery voltage.
- .13 Alternator cooling air outlet temp.
- .2 After completion of 4 hours run, demonstrate following shut down devices and alarms:
  - .1 Overcranking.
  - .2 Overspeed.
  - .3 High engine temp.
  - .4 Low lube oil pressure.
  - .5 Short circuit.
  - .6 Alternator over voltage.
  - .7 Low battery voltage, or no battery charge.
  - .8 Manual remote stand-by stop.
  - .9 High alternator temperature.
- .5 Demonstrate:
  - .1 Automatic starting of set and automatic transfer of load on failure of normal power.
  - .2 Operation of manual bypass switch.
  - .3 Automatic shut down of engine on resumption of normal power.
  - .4 That battery charger reverts to high rate charge after cranking.
- .6 Demonstrate low oil pressure and high engine temperature shutdown devices operation without subjecting engine to these excesses.

### Part 3 – Execution

#### 3.1 INSTALLATION

- .1 Locate generating unit and install as indicated.
- .2 Install fuel supply system as indicated in CSA-B139.
- .3 Install ventilating air duct system as indicated.
- .4 Pipe muffler drains to nearest floor drain.
- .5 Complete wiring and interconnections as indicated.
- .6 Start generating set and test to ensure correct performance of components.

#### 3.2 FIELD QUALITY CONTROL

- .1 Perform tests in accordance with Section 26 05 00 - Common Work Results for Electrical.
- .2 Notify Representative 10 working days in advance of test date.
- .3 Provide fuel for testing and leave full tanks on acceptance.
- .4 Demonstrate:
  - .1 Unit start, transfer to load, retransfer to normal power, unit shut down, on "Automatic" control.

- .2 Unit start and shut down on "Manual" control
  - .3 Unit start and transfer on "Test" control.
  - .4 Unit start on "Engine start" control.
  - .5 Operation of manual bypass switch.
  - .6 Operation of automatic alarms and shut down devices.
- .5 Run unit on load for minimum period of 4 hours load bank followed by the 1-hour building load test. The 1-hour building load test is to simulate a power outage to ensure the ATS activates and the genset turns on. All readings for the tests to be recorded as per CSA C282.
  - .6 At end of test run, check battery voltage to demonstrate battery charger has returned battery to fully charged state.

### **3.3 CLEANING**

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

### **3.4 MAINTENANCE - CLEARANCES**

- .1 Provide clearance around systems, equipment and components for observation of operation, inspection, servicing, maintenance and as recommended by manufacturer and CSA-B139.

**-- END OF SECTION --**

**Part 1 - General****1.1 SECTION INCLUDES**

- .1 Materials and installation for automatic load transfer equipment which can monitor voltage on all phases of normal power supply, initiate cranking of standby generator unit, transfer loads and shut down standby unit.

**1.2 RELATED SECTIONS**

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

**1.3 REFERENCES**

- .1 Canadian Standards Association (CSA International)
  - .1 CAN3-C13-M83(R1998), Instrument Transformers.
  - .2 CSA C22.2No.5-02, Moulded-Case Circuit Breakers, Molded-Case Switches and Circuit-Breaker Enclosures (Tri-national standard with UL 489, tenth edition, and the second edition of NMX-J-266-ANCE).
  - .3 CSA C22.2No.178-1978(R2001), Automatic Transfer Switches.
- .2 American National Standards Institute (ANSI)/National Electrical Manufacturers Association (NEMA)
  - .1 ANSI/NEMA ICS 2-2000, Industrial Control and Systems: Controllers, Contactors, and Overload Relays, Rated Not More Than 2000 Volts AC or 750 Volts DC.

**1.4 SYSTEM DESCRIPTION**

- .1 Automatic load transfer equipment to:
  - .1 Monitor voltage on phases of normal power supply.
  - .2 Initiate cranking of standby generator unit on normal power failure or abnormal voltage on any one phase below preset adjustable limits for adjustable period of time.
  - .3 Transfer load from normal supply to standby unit when standby unit reaches rated frequency and voltage pre-set adjustable limits.
  - .4 Transfer load from standby unit to normal power supply when normal power restored, confirmed by sensing of voltage on phases above adjustable pre-set limit for adjustable time period.
  - .5 Shut down standby unit after running unloaded to cool down using adjustable time delay relay.

**1.5 SHOP DRAWINGS**

- .1 Submit shop drawings.
- .2 Include:
  - .1 Make, model and type.
  - .2 Single line diagram showing controls and relays.

- .3 Description of equipment operation including:
  - .1 Automatic starting and transfer to standby unit and back to normal power.
  - .2 Bypass: A two-way bypass-isolation switch will provide manual bypass of the load to either source and permit isolation of the automatic transfer switch from all source and load power conductors.
  - .2 Test control.
  - .3 Manual control.
  - .4 Automatic shutdown.

## 1.6 CLOSEOUT SUBMITTALS

- .1 Technical data:
  - .1 Schematic diagram of components, controls and relays.
  - .2 Illustrated parts lists with parts catalogue numbers.
  - .3 Certified copy of factory test results.

## 1.7 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate and recycle waste materials in accordance with Construction/Demolition Waste Management and Disposal.
- .2 Remove from site and dispose of all packaging materials at appropriate recycling facilities.
- .3 Collect and separate for disposal paper, plastic, polystyrene, corrugated cardboard packaging material for recycling in accordance with Waste Management Plan.
- .4 Divert unused metal and wiring materials from landfill to metal recycling facility.

## Part 2 - Products

### 2.1 MATERIALS

- .1 Instrument transformers: to CAN3-C13.
- .2 Contactors: to ANSI/NEMA ICS2.

### 2.2 Automatic transfer switches for 3 locations

- .1 Three Automatic transfer switches shall be as below:
  - North River lagoon UV building: Rated: 120/240 VAC, 60Hz, 100A, 1 phase, 2pole/3wire, solid neutral in Nema 1 enclosure.
  - Warren Grove lift station: Rated: 120/208 VAC, 60Hz, 200A, 3 phase, 3pole/4wire, solid neutral in Nema 4X enclosure.
  - River Point Water station: Rated: 120/240 VAC, 60Hz, 100A, 1 phase, 2pole/3wire, solid neutral in Nema 1 enclosure.

**2.3 CONTACTOR TYPE TRANSFER EQUIPMENT**

- .1 Contact Type Transfer Equipment: to CSA C22.2No.178.
- .2 Double throw power transfer arrangement, mechanically and electrically interlocked with microprocessor control with CSA enclosure.
- .3 Rated: as specified
- .4 Main contacts: silver surfaced, protected by arc disruption means.
- .5 Switch and relay contacts, coils, spring and control elements accessible for inspection and maintenance from front of panel without removal of switch panel or disconnection of drive linkages and power conductors.
- .6 Auxiliary contact to initiate back-up generator start-up on failure of normal power.
- .7 Fault withstand rating: 22 kA
- .8 Lever to operate switch manually when switch is isolated.
- .9 Solid neutral bar, rated: 100 A.

**2.4 CIRCUIT BREAKER TYPE TRANSFER EQUIPMENT**

- .1 Circuit Breaker Type Transfer Equipment: to CSA C22.2No.5.
- .2 Rated: as specified
  - .1 Fault withstand rating: 22kA.
  - .2 Molded-case circuit breaker with thermal magnetic, mounted on common base, motor operated, mechanically held and interlocked.
  - .3 One stand-by three phase molded-case circuit breaker with thermal magnetic, mounted on common base, motor operated, mechanically held and interlocked.
  - .4 Circuit breakers:
    - .1 Trip free in closed position.
  - .5 Dead front construction with access to relays and controls for inspection and maintenance, and manual operating lever for transfer switch.
  - .6 Auxiliary contact: to initiate back-up generator start-up on failure of normal power.

**2.5 CONTROLS**

- .1 Selector switch -four position "Test", "Auto", "Manual", "Engine start".
  - .1 Test position - Normal power failure simulated. Engine starts and transfer takes place. Return switch to "Auto" to stop engine.
  - .2 Auto position - Normal operation of transfer switch on failure of normal power; retransfers on return of normal voltage and shuts down engine.
  - .3 Engine start position - Engine starts but unit will not transfer unless normal power supply fails. Switch must be returned to "Auto" to stop engine.
- .2 Control transformers: dry type with 120V secondary to isolate control circuits from:
  - .1 Normal power supply.
  - .2 Stand-by power supply.
- .3 Relays: continuous duty, industrial control type, with wiping action contacts rated 10 A minimum:
  - .1 Voltage sensing: one per phase, solid state type, adjustable drop out and pick up, close differential, 2V minimum under-voltage and over-voltage protection.



- .2 Time delay: normal power to standby, adjustable solid state,
- .3 Time delay on engine starting to override momentary power outages or dips, adjustable delay.
- .4 Time delay on retransfer from standby to normal power, adjustable
- .5 Time delay for engine cool-off to permit standby set to run unloaded after retransfer to normal power, adjustable.

## 2.6 ACCESSORIES

- .1 Pilot lights to indicate power availability normal and standby, switch position, green for normal, red for standby.
- .2 Auxiliary relay to provide N.O. and N.C. contacts for remote alarms.
- .3 Manual bypass.

## 2.7 OPERATION

- .1 Operators
- .2 Controls
  - .1 A four-line, 20 character LCD display and dynamic 4 button keypad shall be an integral part of the controller for viewing all available data and setting desired operational parameters. Operational parameters shall also be available for viewing and control through the communications interface port or USB. The following parameters shall only be adjustable via a password protected programming on the controller:
    - .2 Nominal line voltage and frequency
    - .3 Single or three phase sensing
    - .4 Operating parameter protection
    - .5 Transfer operating mode configuration (Standard transition, Programmed transition, or Closed transition)
- .3 Voltage and Frequency
  - .1 Voltage (all phases) and frequency on both the normal and stand-by sources shall be continuously monitored. Voltage on both normal and stand-by sources and frequency on the stand-by sources shall be adjustable with the following pickup, dropout, and trip setting capabilities (values shown as % of nominal unless otherwise specified):
 

a	Parameter	Dropout/Trip	Pickup/Reset
b	Under voltage	75 to 98%	85 to 100%
c	Over voltage	06 to 135%	95 to 100% of trip
d	Under frequency	95 to 99%	80 to 95%
e	Over frequency	01 to 115%	105 to 120%
f	Voltage unbalance	5 to 20%	3 to 18%
  - .2 Repetitive accuracy of all settings shall be within  $\pm 0.5\%$  over an operating temperature range of  $-20^{\circ}\text{C}$  to  $70^{\circ}\text{C}$ .
  - .3 An adjustable dropout time for transient voltage and frequency excursions shall be provided. The time delays shall be 0.1 to 9.9 seconds for voltage and .1 to 15 seconds for frequency.

- .4 Voltage and frequency settings shall be field adjustable in 1% increments either locally with the display and keypad, remotely via the communications interface port or USB.
  - .5 The controller shall be capable of sensing the phase rotation of both the normal and stand-by sources. The source shall be considered unacceptable if the phase rotation is not the preferred rotation selected (ABC or BAC). Unacceptable phase rotation shall be indicated on the LCD; the service required LED and the annunciation through the communication protocol and dry contacts. In addition, the phase rotation sensing shall be capable of being disabled, if required.
  - .6 The controller shall be capable of detecting a single phasing condition of a source, even though a voltage may be regenerated by the load. This condition is a loss of phase and shall be considered a failed source.
  - .7 Source status screens shall be provided for both normal & stand-by to provide digital readout of voltage on all 3 phases (phase to phase and phase to neutral), frequency, and phase rotation.
- .4 Time Delays
- .1 An adjustable time delay of 0 to 6 seconds shall be provided to override momentary normal source outages and delay all transfer and engine starting signals. Capability shall be provided to extend this time delay to 60 minutes by providing an external 12 or 24 VDC power supply.
  - .2 A time delay shall be provided on transfer to the stand-by source, adjustable from 0 to 60 minutes, for controlled timing of transfer of loads to stand-by.
  - .3 A time delay shall be provided on re-transfer to normal. The time delays shall be adjustable from 0 to 60 minutes. Time delay shall be automatically bypassed if the stand-by source fails and the normal source is acceptable.
  - .4 A time delay shall be provided on shut down of engine generator for cool down, adjustable from 0 to 60 minutes.
  - .5 A time delay activated output signal shall also be provided to drive external relay(s) for selective load disconnect and reconnect control. The controller shall be capable of controlling a maximum of 9 individual output time delays to step loads on after a transfer occurs. Each output may be individually programmed for their own time delay of up to 60 minutes. Each sequence shall be independently programmed for transferring from normal to stand-by and transferring from stand-by to normal.
  - .6 All time delays shall be adjustable in 1 second increments.
  - .7 All time delays shall be adjustable by using the display and keypad, with a remote device connected to the communications interface port or USB.
  - .8 Each time delay shall be identified and a dynamic countdown shall be shown on the display. Active time delays can be viewed with a remote device connected to the communications interface port or USB.
- .5 Additional Features
- .1 The controller shall have 3 levels of security. Level 1 shall allow monitoring of settings and parameters only. The Level 1 shall be capable of restricted with the use of a lockable cover. Level 2 shall allow test functions to be performed and Level 3 shall allow setting of all parameters.

- .2 The display shall provide for the test functions, allowed through password security. The test function shall be load, no load or auto test. The auto test function shall request an elapsed time for test. At the completion of this time delay the test shall be automatically ended and a retransfer sequence shall commence. All loaded tests shall be immediately ended and retransfer shall occur if the stand-by source fails and the normal source is acceptable.
- .3 A contact closure shall be provided for a low-voltage engine start signal. The start signal shall prevent dry cranking of the engine by requiring the generator set to reach proper output and run for the duration of the cool down setting, regardless of whether the normal source restores before the load is transferred.
- .4 Auxiliary contacts shall be provided consisting of a minimum of two contacts, closed when the ATS is connected to the normal source and two contacts closed, when the ATS is connected to the stand-by source.
- .5 LED indicating lights shall be provided; one to indicate when the ATS is connected to the normal source (green) and one to indicate when the ATS is connected to the stand-by source (red).
- .6 LED indicating lights shall be provided and energized by controller outputs. The lights shall provide true source availability of the normal (green) and stand-by sources (red), as determined by the voltage, frequency and phase rotation sensing trip and reset settings for each source.
- .7 A membrane switch shall be provided on the membrane panel to test all indicating lights and display when pressed.
- .8 Provide the ability to select "commit/no commit to transfer" to determine whether the load should be transferred to the back-up generator if the normal source restores before the generator is ready to accept the load.
- .9 Terminals shall be provided for a remote contact which opens to signal the ATS to transfer to stand-by and for remote contacts which closes to inhibit transfer to stand-by and/or retransfer to normal. Both of these inhibit signals can be activated through the keypad, communications interface port or USB. A "not-in-auto" LED shall indicate anytime the controller is inhibiting transfer from occurring.
- .10 An in-phase monitor shall be a standard feature in the controller. The monitor shall control transfer so that motor load inrush currents do not exceed normal starting currents and shall not require external control of power sources. The in-phase monitor shall be specifically designed for and be the product of the ATS manufacturer. The in-phase monitor shall be capable of being enabled or disabled from the user interface, communications interface port or USB.
- .11 A time-based load control feature shall be available to allow the prioritized addition and removal of loads based during transfer. This feature may be enabled for either or both sources. The user shall be able to control up to nine loads with independent timing sequences for pre- and post-transfer delays in either direction of transfer.
- .12 The controller shall provide 2 inputs for external controls that can be programmed from the following values:
  - a. Common fault, Remote test, Inhibit transfer, Low battery voltage, Peak shave, Time delay bypass, Load shed forced to OFF position (Programmed transition only)

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- .13 The controller shall provide two form "C" contact outputs rated for up to 12A @ 240VAC or 2A @ 480VAC that can be programmed from the following values:
- a. Aux switch open, Transfer switch aux contact fault, Alarm silenced, Alarm active, I/O communication loss, Contactor position, Exercise active, Test mode active, Fail to transfer, Fail to acquire standby source, Source available, Phase rotation error, Not in automatic mode, Common alarm, In phase monitor sync, Load bank control active, Load control active, Maintenance mode active, Non-emergency transfer, Fail to open/close, Loss of phase, Over/under voltage, Over/under frequency, Voltage unbalance, Start signal, Peak shave active, Preferred source supplying load, Standby source supplying load
- .14 The controller shall be capable of expanding the number of inputs and outputs with additional modules.
- .15 Optional input/output modules shall be furnished which mount on the inside of the enclosure to facilitate ease of connections.
- .16 Engine Exerciser - The controller shall provide an internal engine exerciser. The engine exerciser shall allow the user to program up to 21 different exercise routines based on a calendar mode. For each routine, the user shall be able to:
- a. Enable or disable the routine
  - b. Enable or disable transfer of the load during routine.
  - c. Set the start time, time of day, day of week, week of month (1st, 2nd, 3rd, 4th, alternate or every)
  - d. Set the duration of the run.
  - e. At the end of the specified loaded exercise duration the switch shall transfer the load back to normal and run the generator for the specified cool down period. All loaded exercises shall be immediately ended and retransfer shall occur if the standby source fails. The next exercise period shall be displayed on the main screen with the type of exercise, time and date. The type of exercise and the time remaining shall be display when the exercise is active. It shall be possible of ending the exercise event with a single button push.
- .17 Date and time - The date shall automatically adjust for leap year and the time shall have the capability of automatically adjusting for daylight saving and standard times.
- .18 System Status - The controller shall have a default display the following on:
- .1 System status
  - .2 Date, time and type of the next exercise event
  - .3 Average voltage of the preferred and standby sources
  - .4 Scrolling through the displays shall indicate the following:
    - a. Line to line and line to neutral voltages for both sources
    - b. Frequency of each source
    - c. Load current for each phase
    - d. Single or three phase operation
    - e. Type of transition
    - f. Preferred source
    - g. Commit or no commit modes of operation
    - h. Source/source mode
    - i. In phase monitor enable/disable
    - j. Phase rotation
    - k. Date and time

- .19 Controllers that require multiple screens to determine system status or display "coded" system status messages, which must be explained by references in the operator's manual, are not permissible.
- .20 Self-Diagnostics - The controller shall contain a diagnostic screen for the purpose of detecting system errors. This screen shall provide information on the status input signals to the controller which may be preventing load transfer commands from being completed.
- .21 Communications Interface - The controller shall be capable of interfacing, through standard communications with a network of transfer switches and generators. It shall be able to be connected via an RS-485 serial communication (up to 4000 ft. direct connect or multi-drop configuration). This module shall allow for seamless integration of existing or new communication transfer devices and generators.
- .22 The transfer switch shall also be able to interface to 3rd party applications using Modbus RTU open standard protocols utilizing Modbus register maps. Proprietary protocols shall not be acceptable.
- .23 The controller shall contain a USB port for use with a software diagnostic application available to factory authorized personnel for downloading the controller's parameters and settings; exercise event schedules; maintenance records and event history. The application can also adjust parameters on the controller.
- .24 Data Logging - The controller shall have the ability to log data and to maintain the last 2000 events, even in the event of total power loss. The following events shall be time and date stamped and maintained in a non-volatile memory. The controller shall be able to display up to the last 99 events. The remaining events shall be accessible via the communications interface port or USB.
  - .1 Event Logging
    - a. Data, date and time indication of any event
  - .2 Statistical Data
    - a. Total number of transfers\*
    - b. Total number of fail to transfers\*
    - c. Total number of transfers due to preferred source failure\*
    - d. Total number of minutes of operation\*
    - e. Total number of minutes in the standby source\*
    - f. Total number of minutes not in the preferred source\*
    - g. Normal to stand-by transfer time
    - h. Stand-by to normal transfer time
    - i. System start date
    - j. Last maintenance date
    - k. \* The statistical data shall be held in two registers. One register shall contain data since start up and the second register shall contain data from the last maintenance reset.
- .25 External DC Power Supply - An optional provision shall be available to connect up to two external 12/24 VDC power supply to allow the LCD and the door mounted control indicators to remain functional when both power sources are dead for extended periods of time. This module shall contain reverse battery connection indication and circuit protection.

**2.8 EQUIPMENT IDENTIFICATION**

- .1 Provide equipment identification in accordance with Section 26 05 00 - Common Work Results – Electrical.

**2.9 SOURCE QUALITY CONTROL**

- .1 Complete equipment, including transfer mechanism, controls, relays and accessories factory assembled and tested.
- .2 Notify Consultant days in advance of date of factory test.
- .3 Tests:
  - .1 Operate equipment both mechanically and electrically to ensure proper performance.
  - .2 Check selector switch, in modes of operation [Test, Auto, Manual, Engine Start] and record results.
  - .3 Check voltage sensing and time delay relay settings.
  - .4 Check:
    - .1 Automatic starting and transfer of load on failure of normal power.
    - .2 Retransfer of load when normal power supply resumed.
    - .3 Automatic shutdown.
    - .4 In-phase monitor operation

**Part 3 - Execution****3.1 INSTALLATION**

- .1 Locate, install and connect transfer equipment.
- .2 Check relays and adjust as required.
- .3 Install and connect batter and remote alarms.

**3.2 FIELD QUALITY CONTROL**

- .1 Perform tests in accordance with Section 26 05 00 - Common Work Results - Electrical.
- .2 Energize transfer equipment from normal power supply.
- .3 Set selector switch in "Test" position to ensure proper standby start, running, transfer, retransfer. Return selector switch to "Auto" position to ensure standby shuts down.
- .4 Set selector switch in "Manual" position and check to ensure proper performance.
- .5 Set selector switch in "Engine start" position and check to ensure proper performance. Return switch to "Auto" to stop engine.
- .6 Set selector switch in "Auto" position and open normal power supply disconnect. Standby should start, come up to rated voltage and frequency, and then load should transfer to standby. Allow to operate for 10 min, then close main power supply disconnect. Load should transfer back to normal power supply and standby should shutdown.
- .7 Repeat, at 1h intervals, 3 times, complete test with selector switch in each position, for each test.

-- END OF SECTION --

**Part 1 - General****1.1 RELATED REQUIREMENTS**

- .1 Section 01 33 00 - Submittal Procedures
- .2 Section 01 45 00 - Quality Control
- .3 Section 01 74 19 - Waste Management and Disposal

**1.2 REFERENCE STANDARDS**

- .1 American Society for Testing and Materials International (ASTM)
  - .1 ASTM C136-05, Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates.
  - .2 ASTM D4318-05, Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils.
- .2 Canadian General Standards Board (CGSB)
  - .1 CAN/CGSB-8.2-M88, Sieves, Testing, Woven Wire, Metric.
- .3 CSA Group (CSA)
  - .1 CAN/CSA-A3000-03, Cementitious Materials Compendium (Consists of A3001, A3002, A3003, A3004 and A3005).
    - .1 CSA-A3001-03, Cementitious Materials for Use in Concrete.
  - .2 CSA-A23.1/A23.2-04, Concrete Materials and Methods of Concrete Construction/Methods of Test and Standard Practices for Concrete.
- .4 U.S. Environmental Protection Agency (EPA)/Office of Water
  - .1 EPA 832R92005, Storm Water Management for Construction Activities: Developing Pollution Prevention Plans and Best Management Practices.

**1.3 DEFINITIONS**

- .1 Excavation classes: two classes of excavation will be recognized; common excavation and rock excavation.
  - .1 Rock: solid material in excess of 1.00 m<sup>3</sup> and which cannot be removed by means of heavy-duty mechanical excavating equipment. Frozen material not classified as rock.
  - .2 Common excavation: excavation of materials of whatever nature, which are not included under definitions of rock excavation.
- .2 Unclassified excavation: excavation of deposits of whatever character encountered in Work.
- .3 Topsoil:
  - .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 millimeters in any dimension.
- .4 Waste material: excavated material unsuitable for use in Work or surplus to requirements.

- .5 Borrow material: material obtained from locations outside area to be graded and required for construction of fill areas or for other portions of Work.
- .6 Recycled fill material: material, considered inert, obtained from alternate sources and engineered to meet requirements of fill areas.
- .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 C136: Sieve sizes to CAN/CGSB-8.2.
- .2 Table:
- | Sieve Designation | % Passing |
|-------------------|-----------|
| 2.00 mm           | 100       |
| 0.10 mm           | 45 – 100  |
| 0.02 mm           | 10 – 80   |
| 0.005 mm          | 0 - 45    |
- .3 Coarse grained soils containing more than 20 % by mass passing 0.075 mm sieve.
- .8 Unshrinkable fill: very weak mixture of cement, concrete aggregates and water that resists settlement when placed in utility trenches, and capable of being readily excavated.

#### 1.4 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Make submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Quality Control: in accordance with Section 01 45 00 - Quality Control:
- .1 Submit condition survey of existing conditions as described in EXISTING CONDITIONS article of this Section.
- .2 Submit to Departmental Representative written notice when bottom of excavation is reached.
- .3 Preconstruction Submittals:
- .1 Submit construction equipment list for major equipment to be used in this section prior to start of Work.
- .2 Submit records of underground utility locates, indicating: location plan of relocated and abandoned services, clearance record from utility authority, location plan of existing utilities as found in field.
- .4 Samples:
- .1 Submit samples in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Inform Departmental Representative at least 2 weeks prior to beginning Work, of proposed source of fill materials and provide access for sampling.



**1.5 QUALITY ASSURANCE**

- .1 Qualification Statement: submit proof of insurance coverage for professional liability.
- .2 Health and Safety Requirements:
  - .1 Do construction occupational health and safety in accordance with Section 01 35 29.06 - Health and Safety Requirements.

**1.6 WASTE MANAGEMENT AND DISPOSAL**

- .1 Separate waste materials for reuse in accordance with Section 01 74 19 - Waste Management and Disposal.
- .2 Divert excess materials from landfill to local facility for reuse as directed by Departmental Representative.

**1.7 EXISTING CONDITIONS**

- .1 Buried services:
  - .1 Before commencing work establish location of buried services on and adjacent to site.
  - .2 Arrange with appropriate authority for relocation of buried services that interfere with execution of work: pay costs of relocating services.
  - .3 Confirm locations of buried utilities by careful test excavations.
  - .4 Maintain and protect from damage, water, sewer, gas, electric, telephone and other utilities and structures encountered.
  - .5 Where utility lines or structures exist in area of excavation, obtain direction of Consultant before proceeding.
  - .6 Record location of maintained, re-routed and abandoned underground lines.
  - .7 Confirm locations of recent excavations adjacent to area of excavation.
- .2 Existing buildings and surface features:
  - .1 Conduct, with Departmental Representative, condition survey of existing buildings, trees and other plants, lawns, fencing, service poles, wires, rail tracks, pavement, survey benchmarks and monuments which may be affected by Work.
  - .2 Protect existing buildings and surface features from damage while Work is in progress. In event of damage, immediately make repair as directed by Departmental Representative.
  - .3 Where required for excavation, cut roots or branches as directed by Departmental Representative.

**Part 2 – Products****2.1 MATERIALS**

- .1 Type 1 and Type 2 fill: properties to the following requirements:
  - .1 Crushed, pit run or screened stone, gravel or sand.
  - .2 Gradations to be within limits specified when tested to ASTM C136. Sieve sizes to CAN/CGSB-8.2.

## .3 Table:

Sieve Designation	% Passing	
Type 1	Type 2	
75 mm	-	100
50 mm	-	-
37.5 mm	-	-
25 mm	100	-
19 mm	75-100	-
12.5 mm	-	-
9.5 mm	50-100	-
4.75 mm	30-70	22-85
2.00 mm	20-45	-
0.425 mm	10-25	5-30
0.180 mm	-	-
0.075 mm	3-8	0-10

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

**Part 3 - Execution****3.1 TEMPORARY EROSION AND SEDIMENTATION CONTROL**

- .1 Provide temporary erosion and sedimentation control measures to prevent soil erosion and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways, according to requirements of authorities having jurisdiction.
- .2 Inspect, repair, and maintain erosion and sedimentation control measures during construction until permanent vegetation has been established.
- .3 Remove erosion and sedimentation controls and restore and stabilize areas disturbed during removal.

**3.2 SITE PREPARATION**

- .1 Remove obstructions, ice and snow, from surfaces to be excavated within limits indicated.
- .2 Cut pavement or sidewalk neatly along limits of proposed excavation in order that surface may break evenly and cleanly.

**3.3 PREPARATION/PROTECTION**

- .1 Keep excavations clean, free of standing water, and loose soil.
- .2 Where soil is subject to significant volume change due to change in moisture content, cover and protect to Departmental Representative approval.
- .3 Protect natural and man-made features required to remain undisturbed. Unless otherwise indicated or located in an area to be occupied by new construction, protect existing trees from damage.
- .4 Protect buried services that are required to remain undisturbed.

**3.4 STOCKPILING**

- .1 Stockpile fill materials in areas designated by Departmental Representative.

- .1 Stockpile granular materials in manner to prevent segregation.
- .2 Protect fill materials from contamination.
- .3 Implement sufficient erosion and sediment control measures to prevent sediment release off construction boundaries and into water bodies.

### **3.5 DEWATERING AND HEAVE PREVENTION**

- .1 Keep excavations free of water while Work is in progress.

### **3.6 EXCAVATION**

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

### **3.7 BEDDING AND SURROUND OF UNDERGROUND SERVICES**

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

### **3.8 BACKFILLING**

- .1 Do not proceed with backfilling operations until completion of following:
  - .1 Departmental Representative has inspected and approved installations.

- .2 Departmental Representative has inspected and approved of construction below finish grade.
  - .3 Inspection, testing, approval, and recording location of underground utilities.
  - .4 Removal of concrete formwork.
  - .5 Removal of shoring and bracing; backfilling of voids with satisfactory soil material.
- .2 Areas to be backfilled to be free from debris, snow, ice, water and frozen ground.
  - .3 Do not use backfill material which is frozen or contains ice, snow or debris.
  - .4 Place backfill material in uniform layers not exceeding 150 mm compacted thickness up to grades indicated. Compact each layer before placing succeeding layer.
  - .5 Backfilling around installations:
    - .1 Place bedding and surround material as specified elsewhere.
    - .2 Place layers simultaneously on both sides of installed Work to equalize loading.
  - .6 Consolidate and level unshrinkable fill with internal vibrators.

### **3.9 RESTORATION**

- .1 Upon completion of Work, remove waste materials and debris in accordance to Section 01 74 19 - Waste Management and Disposal, trim slopes, and correct defects as directed by Departmental Representative.
- .2 Replace topsoil as indicated as directed by Departmental Representative.
- .3 Reinstate lawns to elevation which existed before excavation.
- .4 Reinstate pavements and sidewalks disturbed by excavation to thickness, structure and elevation which existed before excavation.
- .5 Clean and reinstate areas affected by Work as directed by Departmental Representative.
- .6 Use temporary plating to support traffic loads over unshrinkable fill for initial 24 hours.
- .7 Protect newly graded areas from traffic and erosion and maintain free of trash or debris.

**-- END OF SECTION --**