THE CITY OF WINNIPEG

BID OPPORTUNITY

BID OPPORTUNITY NO. 837-2009

SEWPCC ELECTRICAL INSPECTION AND UPGRADES

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B2. SUBMISSION DEADLINE

B2.1 The Submission Deadline is 4:00 p.m. Winnipeg time, December 23, 2009.

B2.2 Bids determined by the Manager of Materials to have been received later than the Submission Deadline will not be accepted and will be returned upon request.

B2.3 The Contract Administrator or the Manager of Materials may extend the Submission Deadline by issuing an addendum at any time prior to the time and date specified in B2.1.

B3. SITE INVESTIGATION

B3.1 Further to C3.1, the Contract Administrator or an authorized representative will be available at the Site at 9:00 am on December 16, 2009 to provide Bidders access to the Site. Bidders must be at the front entrance of the SEWPCC facility at 1:30 pm sharp to obtain access.

B3.2 The Bidder shall not be entitled to rely on any information or interpretation received at the Site investigation unless that information or interpretation is the Bidder's direct observation, or is provided by the Contract Administrator in writing.

B4. ENQUIRIES

B4.1 All enquiries shall be directed to the Contract Administrator identified in D4.1.

B4.2 If the Bidder finds errors, discrepancies or omissions in the Bid Opportunity, or is unsure of the meaning or intent of any provision therein, the Bidder shall notify the Contract Administrator of the error, discrepancy or omission, or request a clarification as to the meaning or intent of the provision at least five (5) Business Days prior to the Submission Deadline.

B4.3 Responses to enquiries which, in the sole judgment of the Contract Administrator, require a correction to or a clarification of the Bid Opportunity will be provided by the Contract Administrator to all Bidders by issuing an addendum.

B4.4 Responses to enquiries which, in the sole judgment of the Contract Administrator, do not require a correction to or a clarification of the Bid Opportunity will be provided by the Contract Administrator only to the Bidder who made the enquiry.

B4.5 The Bidder shall not be entitled to rely on any response or interpretation received pursuant to B4 unless that response or interpretation is provided by the Contract Administrator in writing.

B5. ADDENDA

B5.1 The Contract Administrator may, at any time prior to the Submission Deadline, issue addenda correcting errors, discrepancies or omissions in the Bid Opportunity, or clarifying the meaning or intent of any provision therein.

B5.2 The Contract Administrator will issue each addendum at least two (2) Business Days prior to the Submission Deadline, or provide at least two (2) Business Days by extending the Submission Deadline.

B5.2.1 Addenda will be available on the Bid Opportunities page at The City of Winnipeg, Corporate Finance, Materials Management Division website at http://www.winnipeg.ca/matmgt

B5.2.2 The Bidder is responsible for ensuring that he has received all addenda and is advised to check the Materials Management Division website for addenda regularly and shortly before the Submission Deadline, as may be amended by addendum.

B5.2.3 The Bidder shall acknowledge receipt of each addendum in Paragraph 8 of Form A: Bid. Failure to acknowledge receipt of an addendum may render a Bid non-responsive.

B6. SUBSTITUTES

B6.1 The Work is based on the Plant, Materials and methods specified in the Bid Opportunity.

B6.2 Substitutions shall not be allowed unless application has been made to and prior approval has been granted by the Contract Administrator in writing.

B6.3 Requests for approval of a substitute will not be considered unless received in writing by the Contract Administrator at least five (5) Business Days prior to the Submission Deadline.

B6.4 The Bidder shall ensure that any and all requests for approval of a substitute:

(a) provide sufficient information and details to enable the Contract Administrator to determine the acceptability of the Plant, Material or method as either an approved equal or alternative;

(b) identify any and all changes required in the applicable Work, and all changes to any other Work, which would become necessary to accommodate the substitute;

(c) identify any anticipated cost or time savings that may be associated with the substitute;

(d) certify that, in the case of a request for approval as an approved equal, the substitute will fully perform the functions called for by the general design, be of equal or superior substance to that specified, is suited to the same use and capable of performing the same function as that specified and can be incorporated into the Work, strictly in accordance with the proposed work schedule and the dates specified in the Supplemental Conditions for Substantial Performance and Total Performance;

(e) certify that, in the case of a request for approval as an approved alternative, the substitute will adequately perform the functions called for by the general design, be similar in substance to that specified, is suited to the same use and capable of performing the same function as that specified and can be incorporated into the Work, strictly in accordance with the proposed work schedule and the dates specified in the Supplemental Conditions for Substantial Performance and Total Performance.

B6.5 The Contract Administrator, after assessing the request for approval of a substitute, may in his sole discretion grant approval for the use of a substitute as an “approved equal” or as an “approved alternative”, or may refuse to grant approval of the substitute.

B6.6 The Contract Administrator will provide a response in writing, at least two (2) Business Days prior to the Submission Deadline, only to the Bidder who requested approval of the substitute.

B6.6.1 The Bidder requesting and obtaining the approval of a substitute shall be entirely responsible for disseminating information regarding the approval to any person or persons he wishes to inform.

B6.7 If the Contract Administrator approves a substitute as an “approved equal”, any Bidder may use the approved equal in place of the specified item.

B6.8 If the Contract Administrator approves a substitute as an “approved alternative”, any Bidder bidding that approved alternative may base his Total Bid Price upon the specified item but may also indicate an alternative price based upon the approved alternative. Such alternatives will be evaluated in accordance with B14.

B6.9 No later claim by the Contractor for an addition to the Total Bid Price because of any other changes in the Work necessitated by the use of an approved equal or an approved alternative will be considered.

B6.10 Notwithstanding B6.2 to B6.9, and in accordance with B7.7, deviations inconsistent with the Bid Opportunity document shall be evaluated in accordance with B14.1(a).

B7. BID COMPONENTS

B7.1 The Bid shall consist of the following components:

(a) Form A: Bid;

(b) Form B: Prices;

B7.2 Further to B7.1, the Bidder should include the written correspondence from the Contract Administrator approving a substitute in accordance with B6.

B7.3 All components of the Bid shall be fully completed or provided, and submitted by the Bidder no later than the Submission Deadline, with all required entries made clearly and completely, to constitute a responsive Bid.

B7.4 The Bid Submission may be submitted by mail, courier or personal delivery, or by facsimile transmission.

B7.5 If the Bid Submission is submitted by mail, courier or personal delivery, it shall be enclosed and sealed in an envelope clearly marked with the Bid Opportunity number and the Bidder's name and address, and shall be submitted to:

The City of Winnipeg
Corporate Finance Department
Materials Management Division
185 King Street, Main Floor
Winnipeg, MB R3B 1J1

B7.5.1 Samples or other components of the Bid Submission which cannot reasonably be enclosed in the envelope may be packaged separately, but shall be clearly marked with the Bid Opportunity number, the Bidder's name and address, and an indication that the contents are part of the Bidder’s Bid Submission.

B7.6 Bidders are advised not to include any information/literature except as requested in accordance with B7.1.

B7.7 Bidders are advised that inclusion of terms and conditions inconsistent with the Bid Opportunity document, including the General Conditions, will be evaluated in accordance with B14.1(a).

B7.8 If the Bid Submission is submitted by facsimile transmission, it shall be submitted to (204) 949-1178.

B7.8.1 The Bidder is advised that the City cannot take responsibility for the availability of the facsimile machine at any time.

B7.8.2 Bids submitted by internet electronic mail (e-mail) will not be accepted.

B8. BID

B8.1 The Bidder shall complete Form A: Bid, making all required entries.

B8.2 Paragraph 2 of Form A: Bid shall be completed in accordance with the following requirements:

(a) if the Bidder is a sole proprietor carrying on business in his own name, his name shall be inserted;

(b) if the Bidder is a partnership, the full name of the partnership shall be inserted;

(c) if the Bidder is a corporation, the full name of the corporation shall be inserted;

(d) if the Bidder is carrying on business under a name other than his own, the business name and the name of every partner or corporation who is the owner of such business name shall be inserted.

B8.2.1 If a Bid is submitted jointly by two or more persons, each and all such persons shall identify themselves in accordance with B8.2.

B8.3 In Paragraph 3 of Form A: Bid, the Bidder shall identify a contact person who is authorized to represent the Bidder for purposes of the Bid.

B8.4 Paragraph 10 of Form A: Bid shall be signed in accordance with the following requirements:

(a) if the Bidder is a sole proprietor carrying on business in his own name, it shall be signed by the Bidder;

(b) if the Bidder is a partnership, it shall be signed by the partner or partners who have authority to sign for the partnership;

(c) if the Bidder is a corporation, it shall be signed by its duly authorized officer or officers;

(d) if the Bidder is carrying on business under a name other than his own, it shall be signed by the registered owner of the business name, or by the registered owner's authorized officials if the owner is a partnership or a corporation.

B8.4.1 The name and official capacity of all individuals signing Form A: Bid should be printed below such signatures.

B8.4.2 All signatures shall be original.

B8.5 If a Bid is submitted jointly by two or more persons, the word "Bidder" shall mean each and all such persons, and the undertakings, covenants and obligations of such joint Bidders in the Bid and the Contract, when awarded, shall be both joint and several.

B9. PRICES

B9.1 The Bidder shall state a price in Canadian funds for each item of the Work identified on Form B: Prices.

B9.1.1 Notwithstanding C12.2.3(c), prices on Form B: Prices shall not include the Manitoba Retail Sales Tax (MRST, also known as PST), which shall be extra where applicable.

B9.2 The quantities listed on Form B: Prices are to be considered approximate only. The City will use said quantities for the purpose of comparing Bids.

B9.3 The quantities for which payment will be made to the Contractor are to be determined by the Work actually performed and completed by the Contractor, to be measured as specified in the applicable Specifications.

B9.4 The mark-up factor for material, specified on Form B, Item 14, shall be a multiplier between 1.00 and 1.50, that when multiplied by the base cost, shall represent the total price including the Contractor’s additional handling charge and profit to supply the material. The total price for the material shall be the base cost multiplied by the mark-up factor.

(a) The mark-up factor shall be based upon the Contractor’s base cost. This base cost shall be the Contractor’s procurement cost, or if the material is manufactured by the Contractor, the internal wholesale cost.

B9.5 Prices from Non-Resident Bidders are subject to a Non-Resident Withholding Tax pursuant to the Income Tax Act (Canada).

B10. QUALIFICATION

B10.1 The Bidder shall:

(a) undertake to be in good standing under The Corporations Act (Manitoba), or properly registered under The Business Names Registration Act (Manitoba), or otherwise properly registered, licensed or permitted by law to carry on business in Manitoba; and

(b) be financially capable of carrying out the terms of the Contract; and

(c) have all the necessary experience, capital, organization, and equipment to perform the Work in strict accordance with the terms and provisions of the Contract.

B10.2 The Bidder and any proposed Subcontractor (for the portion of the Work proposed to be subcontracted to them) shall:

(a) be responsible and not be suspended, debarred or in default of any obligations to the City. A list of suspended or debarred individuals and companies is available on the Information Connection page at The City of Winnipeg, Corporate Finance, Materials Management Division website at http://www.winnipeg.ca/matmgt/debar.stm

B10.3 The Bidder and/or any proposed Subcontractor (for the portion of the Work proposed to be subcontracted to them) shall:

(a) have successfully carried out work similar in nature, scope and value to the Work; and

(b) be fully capable of performing the Work required to be in strict accordance with the terms and provisions of the Contract; and

(c) have a written workplace safety and health program if required pursuant to The Workplace Safety and Health Act (Manitoba);

(d) be regularly engaged in the testing of electrical equipment devices, installations, and systems;

(e) utilize licensed electricians for tasks as required to meet Manitoba regulations; and

(f) use technicians who are regularly employed for testing services. Technicians performing these electrical tests and inspections shall be trained and experienced concerning the apparatus and systems being evaluated. These individuals shall be capable of conducting the tests in a safe manner and with complete knowledge of the hazards involved. They must evaluate the test data and make a judgment on the continued serviceability or non-serviceability of the specific equipment.

B10.4 Further to B10.3(c), the Bidder shall, within five (5) Business Days of a request by the Contract Administrator, provide proof satisfactory to the Contract Administrator that the Bidder/Subcontractors has a workplace safety and health program meeting the requirements of The Workplace Safety and Health Act (Manitoba), by providing:

(a) a valid COR certification number under the Certificate of Recognition (COR) Program administered by the Manitoba Construction Safety Association or by the Manitoba Heavy Construction Association's Safety, Health and Environment Program; or

(b) a report or letter to that effect from an independent reviewer acceptable to the City. (A list of acceptable reviewers and the review template are available on the Information Connection page at The City of Winnipeg, Corporate Finance, Materials Management Division website at http://www.winnipeg.ca/matmgt)

B10.5 The Bidder shall submit, within three (3) Business Days of a request by the Contract Administrator, proof satisfactory to the Contract Administrator of the qualifications of the Bidder and of any proposed Subcontractor.

B10.6 The Bidder shall provide, on the request of the Contract Administrator, full access to any of the Bidder's equipment and facilities to confirm, to the Contract Administrator's satisfaction, that the Bidder's equipment and facilities are adequate to perform the Work.

B11. OPENING OF BIDS AND RELEASE OF INFORMATION

B11.1 Bids will not be opened publicly.

B11.2 Following the submission deadline, the names of the Bidders and their Total Bid Prices (unevaluated, and pending review and verification of conformance with requirements) will be available on the Closed Bid Opportunities (or Public/Posted Opening & Award Results) page at The City of Winnipeg, Corporate Finance, Materials Management Division website at http://www.winnipeg.ca/matmgt/bidopp.asp

B11.3 After award of Contract, the name(s) of the successful Bidder(s) and the Contract Amount(s) will be available on the Closed Bid Opportunities (or Public/Posted Opening & Award Results) page at The City of Winnipeg, Corporate Finance, Materials Management Division website at http://www.winnipeg.ca/matmgt

B11.4 The Bidder is advised that any information contained in any Bid may be released if required by City policy or procedures, by The Freedom of Information and Protection of Privacy Act (Manitoba), by other authorities having jurisdiction, or by law.

B12. IRREVOCABLE BID

B12.1 The Bid(s) submitted by the Bidder shall be irrevocable for the time period specified in Paragraph 9 of Form A: Bid.

B12.2 The acceptance by the City of any Bid shall not release the Bids of the next two lowest evaluated responsive Bidders and these Bidders shall be bound by their Bids on such Work for the time period specified in Paragraph 9 of Form A: Bid.

B13. WITHDRAWAL OF BIDS

B13.1 A Bidder may withdraw his Bid without penalty by giving written notice to the Manager of Materials at any time prior to the Submission Deadline.

B13.1.1 Notwithstanding C23.3, the time and date of receipt of any notice withdrawing a Bid shall be the time and date of receipt as determined by the Manager of Materials.

B13.1.2 The City will assume that any one of the contact persons named in Paragraph 3 of Form A: Bid or the Bidder's authorized representatives named in Paragraph 10 of Form A: Bid, and only such person, has authority to give notice of withdrawal.

B13.1.3 If a Bidder gives notice of withdrawal prior to the Submission Deadline, the Manager of Materials will:

(a) retain the Bid until after the Submission Deadline has elapsed;

(b) open the Bid to identify the contact person named in Paragraph 3 of Form A: Bid and the Bidder's authorized representatives named in Paragraph 10 of Form A: Bid; and

(c) if the notice has been given by any one of the persons specified in B13.1.3(b), declare the Bid withdrawn.

B13.2 A Bidder who withdraws his Bid after the Submission Deadline but before his Bid has been released or has lapsed as provided for in B12.2 shall be liable for such damages as are imposed upon the Bidder by law and subject to such sanctions as the Chief Administrative Officer considers appropriate in the circumstances. The City, in such event, shall be entitled to all rights and remedies available to it at law.

B14. EVALUATION OF BIDS

B14.1 Award of the Contract shall be based on the following bid evaluation criteria:

(a) compliance by the Bidder with the requirements of the Bid Opportunity or acceptable deviation there from (pass/fail);

(b) qualifications of the Bidder and the Subcontractors, if any, pursuant to B10 (pass/fail);

(c) Total Bid Price;

(d) economic analysis of any approved alternative pursuant to B6.

B14.2 Further to B14.1(a), the Award Authority may reject a Bid as being non-responsive if the Bid is incomplete, obscure or conditional, or contains additions, deletions, alterations or other irregularities. The Award Authority may reject all or any part of any Bid, or waive technical requirements or minor informalities or irregularities, if the interests of the City so require.

B14.3 Further to B14.1(b), the Award Authority shall reject any Bid submitted by a Bidder who does not demonstrate, in his Bid or in other information required to be submitted, that he is responsible and qualified.

B14.4 Further to B14.1(c), the Total Bid Price shall be the sum of the quantities multiplied by the unit prices for each item shown on Form B: Prices.

B14.4.1 If there is any discrepancy between the Total Bid Price written in figures, the Total Bid Price written in words and the sum of the quantities multiplied by the unit prices for each item, the sum of the quantities multiplied by the unit prices for each item shall take precedence.

B14.4.2 Further to B14.1(a), in the event that a unit price is not provided on Form B: Prices, the City will determine the unit price by dividing the Amount (extended price) by the approximate quantity, for the purposes of evaluation and payment.

B15. AWARD OF CONTRACT

B15.1 The City will give notice of the award of the Contract or will give notice that no award will be made.

B15.2 The City will have no obligation to award a Contract to a Bidder, even though one or all of the Bidders are determined to be responsible and qualified, and the Bids are determined to be responsive.

B15.2.1 Without limiting the generality of B15.2, the City will have no obligation to award a Contract where:

(a) the prices exceed the available City funds for the Work;

(b) the prices are materially in excess of the prices received for similar work in the past;

(c) the prices are materially in excess of the City's cost to perform the Work, or a significant portion thereof, with its own forces;

(d) only one Bid is received; or

(e) in the judgment of the Award Authority, the interests of the City would best be served by not awarding a Contract.

B15.3 Where an award of Contract is made by the City, the award shall be made to the responsible and qualified Bidder submitting the lowest evaluated responsive Bid, in accordance with B14.

B15.3.1 Following the award of contract, a Bidder will be provided with information related to the evaluation of his Bid upon written request to the Contract Administrator.

B15.4 Notwithstanding C4, the City will issue a Purchase Order to the successful Bidder in lieu of the execution of a Contract.

B15.5 The Contract, as defined in C1.1, in its entirety shall be deemed to be incorporated in and to form a part of the Purchase Order notwithstanding that it is not necessarily attached to or accompany said Purchase Order.

PART C - GENERAL CONDITIONS

C0. GENERAL CONDITIONS

C0.1 The *General Conditions for Construction* (Revision 2006 12 15) are applicable to the Work of the Contract.

C0.1.1 The *General Conditions for Construction* are available on the Information Connection page at The City of Winnipeg, Corporate Finance, Materials Management Division website at http://www.winnipeg.ca/matmgt/gen_cond.stm

C0.2 A reference in the Bid Opportunity to a section, clause or subclause with the prefix "**C**" designates a section, clause or subclause in the *General Conditions for Construction*.

PART D - SUPPLEMENTAL CONDITIONS

GENERAL

D1. GENERAL CONDITIONS

D1.1 In addition to the *General Conditions for Construction*, these Supplemental Conditions are applicable to the Work of the Contract.

D2. SCOPE OF WORK

D2.1 The Work to be done under the Contract shall consist of condition assessment, basic maintenance and performance testing of the specified electrical equipment within the SEWPCC facility. The Work will also include the upgrade of specified switchgear controls including undervoltage relay monitoring and remote breaker control.

D2.2 The major components of the Work are as follows:

(a) Perform a thermographic inspection.

(b) Test grounding/bonding connections.

(c) Inspect and test the 600 V busway between the Manitoba Hydro transformers and the SEWPCC facility.

(d) Inspect and test the 600 V, 4000A main switchgear within the Secondary Clarifier Electrical Room.

(e) Inspect and test the busways and feeder cables to the MCCs.

(f) Inspect and test the MCCs including starters, feeder breakers, and capacitors.

(g) Inspect and test 600V panelboards.

(h) Inspect and test 120/208V panelboards.

(i) Inspect and test low voltage transformers.

(j) Inspect and test feeder cables between transformers and panelboards.

(k) Inspect and test six 600V motors (250HP and above) including cables.

(l) Inspect and test four 600V VFDs.

(m) Inspect and test the 85 kW generator, transfer switch, and associated components.

(n) Inspect and test the 1000 kW generator, transfer switch, and associated components.

(o) Perform harmonics measurements.

(p) Perform the following switchgear upgrades:

(i) Connect six existing power monitoring relay contacts to DCS discrete inputs.

(ii) Modify wiring and other miscellaneous changes to the generator control panel GCP-5 and raw sewage pump VFDs.

(iii) Modify the Main Switchgear to remove the existing undervoltage relays, install voltmeters, and install remote main breaker control.

(q) Provide a report detailing the inspection and test results.

(r) Provide a quotation to repair defective components using the rates proposed in Form B.

(s) Repair defective components upon approval of the Contract Administrator. Award of this contract does not imply approval of the repair services.

D3. DEFINITIONS

D3.1 When used in this Bid Opportunity:

(a) ***"CSA**" means Canadian Standards Association..*

(b) ***"MCC"*** *means Motor Control Centre.*

(c) ***"RTD"*** *means Resistance Temperature Device.*

(d) "**SEWPCC**" means the South End Water Pollution Control Centre.

(e) *"**VFD**" means Variable Frequency Drive*.

D4. CONTRACT ADMINISTRATOR

D4.1 The Contract Administrator is SNC-Lavalin Inc, represented by:

Curtis Reimer, P.Eng.
SNC-Lavalin Inc.
148 Nature park Way,
Winnipeg, MB R3P 0X7

E-mail curtis.reimer@snclavalin.com

Telephone No. (204) 786-8080
Facsimile No. (204) 786-7934

D4.2 At the pre-construction meeting, Curtis Reimer will identify additional personnel representing the Contract Administrator and their respective roles and responsibilities for the Work.

D5. CONTRACTOR'S SUPERVISOR

D5.1 At the pre-construction meeting, the Contractor shall identify his designated supervisor and any additional personnel representing the Contractor and their respective roles and responsibilities for the Work.

D6. NOTICES

D6.1 Except as provided for in C23.2.2, all notices, requests, nominations, proposals, consents, approvals, statements, authorizations, documents or other communications to the Contractor shall be sent to the address or facsimile number identified by the Contractor in Paragraph 2 of Form A: Bid.

D6.2 All notices, requests, nominations, proposals, consents, approvals, statements, authorizations, documents or other communications to the City, except as expressly otherwise required in D6.3, D6.4 or elsewhere in the Contract, shall be sent to the attention of the Contract Administrator at the address or facsimile number identified in D4.1.

D6.3 Notwithstanding C21., all notices of appeal to the Chief Administrative Officer shall be sent to the attention of the Chief Financial Officer at the following address or facsimile number:

The City of Winnipeg
Chief Financial Officer
Administration Building, 3rd Floor
510 Main Street
Winnipeg MB R3B 1B9

Facsimile No.: (204) 949-1174

D6.4 All notices, requests, nominations, proposals, consents, approvals, statements, authorizations, documents or other communications required to be submitted or returned to the City Solicitor shall be sent to the following address or facsimile number:

The City of Winnipeg
Internal Services Department
Legal Services Division
Attn: City Solicitor
185 King Street, 3rd Floor
Winnipeg MB R3B 1J1

Facsimile No.: (204) 947-9155

SUBMISSIONS

D7. AUTHORITY TO CARRY ON BUSINESS

D7.1 The Contractor shall be in good standing under The Corporations Act (Manitoba), or properly registered under The Business Names Registration Act (Manitoba), or otherwise properly registered, licensed or permitted by law to carry on business in Manitoba, or if the Contractor does not carry on business in Manitoba, in the jurisdiction where the Contractor does carry on business, throughout the term of the Contract, and shall provide the Contract Administrator with evidence thereof upon request.

D8. SAFE WORK PLAN

D8.1 The Contractor shall provide the Contract Administrator with a Safe Work Plan at least five (5) Business Days prior to the commencement of any Work on the Site but in no event later than the date specified in C4.1 for the return of the executed Contract.

D8.2 The Safe Work Plan should be prepared and submitted in the format shown in the City's template which is available on the Information Connection page at The City of Winnipeg, Corporate Finance, Materials Management Division website at http://www.winnipeg.ca/matmgt/Safety/default.stm

D9. INSURANCE

D9.1 The Contractor shall provide and maintain the following insurance coverage:

(a) commercial general liability insurance, in the amount of at least two million dollars ($2,000,000.00) inclusive, with The City of Winnipeg added as an additional insured, with a cross-liability clause, such liability policy to also contain contractual liability, unlicensed motor vehicle liability, non-owned automobile liability and products and completed operations, to remain in place at all times during the performance of the Work and throughout the warranty period;

(b) automobile liability insurance for owned automobiles used for or in connection with the Work in the amount of at least two million dollars ($2,000,000.00) at all times during the performance of the Work and until the date of Total Performance;

D9.2 Deductibles shall be borne by the Contractor.

D9.3 The Contractor shall provide the Contract Administrator with a certificate(s) of insurance, in a form satisfactory to the City Solicitor, at least two (2) Business Days prior to the commencement of any Work but in no event later than seven (7) Calendar Days from notification of the award of Contract by Purchase Order.

D9.4 The Contractor shall not cancel, materially alter, or cause each policy to lapse without providing at least thirty (30) Calendar Days prior written notice to the Contract Administrator.

D10. PERFORMANCE SECURITY

D10.1 If the Contract Price exceeds twenty-five thousand dollars ($25,000.00), the Contractor shall provide and maintain performance security until the expiration of the warranty period in the form of:

(a) a performance bond of a company registered to conduct the business of a surety in Manitoba, in the form attached to these Supplemental Conditions (Form H1: Performance Bond), in the amount of fifty percent (50%) of the Contract Price; or

(b) an irrevocable standby letter of credit issued by a bank or other financial institution registered to conduct business in Manitoba and drawn on a branch located in Winnipeg, in

the form attached to these Supplemental Conditions (Form H2: Irrevocable Standby Letter of Credit), in the amount of fifty percent (50%) of the Contract Price; or

(c) a certified cheque or draft payable to "The City of Winnipeg", drawn on a bank or other financial institution registered to conduct business in Manitoba, in the amount of fifty percent (50%) of the Contract Price.

D10.1.1 Where the performance security is in the form of a certified cheque or draft, it will be deposited by the City. The City will not pay any interest on certified cheques or drafts furnished as performance security.

D10.2 The Contractor shall provide the City Solicitor with the required performance security within seven (7) Calendar Days of notification of the award of the Contract by way of Purchase Order and prior to the commencement of any Work on the Site.

SCHEDULE OF WORK

D11. COMMENCEMENT

D11.1 The Contractor shall not commence any Work until he is in receipt of a Purchase Order from the Award Authority authorizing the commencement of the Work.

D11.2 The Contractor shall not commence any Work on the Site until:

(a) the Contract Administrator has confirmed receipt and approval of:
  (i) evidence of authority to carry on business specified in D7;
  (ii) evidence of the workers compensation coverage specified in C6.15;
  (iii) the Safe Work Plan specified in D8;
  (iv) evidence of the insurance specified in D9;
  (v) the performance security specified in D10;

(b) the Contractor has attended a pre-construction meeting with the Contract Administrator, or the Contract Administrator has waived the requirement for a pre-construction meeting.

D11.3 The Contractor shall commence the Work on the Site within fifteen (15) Working Days of receipt of the Purchase Order.

D12. SUBSTANTIAL PERFORMANCE

D12.1 The Contractor shall achieve Substantial Performance within sixty (60) consecutive Working Days of the commencement of the Work as specified in D11.

D12.2 When the Contractor considers the Work to be substantially performed, the Contractor shall arrange, attend and assist in the inspection of the Work with the Contract Administrator for purposes of verifying Substantial Performance. Any defects or deficiencies in the Work noted during that inspection shall be remedied by the Contractor at the earliest possible instance and the Contract Administrator notified so that the Work can be reinspected.

D12.3 The date on which the Work has been certified by the Contract Administrator as being substantially performed to the requirements of the Contract through the issue of a certificate of Substantial Performance is the date on which Substantial Performance has been achieved.

D13. TOTAL PERFORMANCE

D13.1 The Contractor shall achieve Total Performance within eighty (80) consecutive Working Days of the commencement of the Work as specified in D11.

D13.2 When the Contractor or the Contract Administrator considers the Work to be totally performed, the Contractor shall arrange, attend and assist in the inspection of the Work with the Contract Administrator for purposes of verifying Total Performance. Any defects or deficiencies in the

Work noted during that inspection shall be remedied by the Contractor at the earliest possible instance and the Contract Administrator notified so that the Work can be reinspected.

D13.3 The date on which the Work has been certified by the Contract Administrator as being totally performed to the requirements of the Contract through the issue of a certificate of Total Performance is the date on which Total Performance has been achieved.

CONTROL OF WORK

D14. JOB MEETINGS

D14.1 Regular job meetings will be held at the Site. Allow for twelve progress/scheduling meetings. These meetings shall be attended by a minimum of one representative of the Contract Administrator, one representative of the City and one representative of the Contractor. Each representative shall be a responsible person capable of expressing the position of the Contract Administrator, the City and the Contractor respectively on any matter discussed at the meeting including the Work schedule and the need to make any revisions to the Work schedule. The progress of the Work will be reviewed at each of these meetings.

D14.2 The Contract Administrator reserves the right to cancel any job meeting or call additional job meetings whenever he deems it necessary.

D15. PRIME CONTRACTOR – THE WORKPLACE SAFETY AND HEALTH ACT (MANITOBA)

D15.1 Further to C6.24, the Contractor shall be the Prime Contractor and shall serve as, and have the duties of the Prime Contractor in accordance with The Workplace Safety and Health Act (Manitoba).

MEASUREMENT AND PAYMENT

D16. PAYMENT

D16.1 Further to C12, the City may at its option pay the Contractor by direct deposit to the Contractor's banking institution.

D17. PAYMENT SCHEDULE

D17.1 Further to C12, payment shall be in accordance with the following payment schedule:

(a) A maximum of 90% of Form B, Item 1 through Item 11 may be submitted for progress payments prior to the total completion of the associated services. The remaining 10% will be paid out upon total completion all of the inspection services, including the required report.

(b) A maximum of 90% of Form B, Item 12 may be submitted for progress payments prior to the total completion of the associated services, including the provision of record drawing mark-ups.

(c) Form B, Item 13 may only be submitted for progress payments after the camera is turned over and accepted by the City of Winnipeg.

(d) For authorized repair services, a maximum of 90% of any quoted amount may be submitted for progress payment prior to the total completion of the associated services.

WARRANTY

D18. WARRANTY

D18.1 Warranty is as stated in C13.

FORM H1: PERFORMANCE BOND
(See D10)

KNOW ALL MEN BY THESE PRESENTS THAT

_____
(hereinafter called the "Principal"), and

_____ ,
(hereinafter called the "Surety"), are held and firmly bound unto **THE CITY OF WINNIPEG** (hereinafter called the "Obligee"), in the sum of

_____

_____ dollars ($_____.____)

of lawful money of Canada to be paid to the Obligee, or its successors or assigns, for the payment of which sum the Principal and the Surety bind themselves, their heirs, executors, administrators, successors and assigns, jointly and severally, firmly by these presents.

WHEREAS the Principal has entered into a written contract with the Obligee for

BID OPPORTUNITY NO. 837-2009

SEWPCC ELECTRICAL INSPECTION AND UPGRADES

which is by reference made part hereof and is hereinafter referred to as the “Contract”.

NOW THEREFORE the condition of the above obligation is such that if the Principal shall:

(a) carry out and perform the Contract and every part thereof in the manner and within the times set forth in the Contract and in accordance with the terms and conditions specified in the Contract;
(b) perform the Work in a good, proper, workmanlike manner;
(c) make all the payments whether to the Obligee or to others as therein provided;
(d) in every other respect comply with the conditions and perform the covenants contained in the Contract; and
(e) indemnify and save harmless the Obligee against and from all loss, costs, damages, claims, and demands of every description as set forth in the Contract, and from all penalties, assessments, claims, actions for loss, damages or compensation whether arising under "The Workers Compensation Act", or any other Act or otherwise arising out of or in any way connected with the performance or non-performance of the Contract or any part thereof during the term of the Contract and the warranty period provided for therein;

THEN THIS OBLIGATION SHALL BE VOID, but otherwise shall remain in full force and effect. The Surety shall not, however, be liable for a greater sum than the sum specified above.

AND IT IS HEREBY DECLARED AND AGREED that the Surety shall be liable as Principal, and that nothing of any kind or matter whatsoever that will not discharge the Principal shall operate as a discharge or release of liability of the Surety, any law or usage relating to the liability of Sureties to the contrary notwithstanding.

IN WITNESS WHEREOF the Principal and Surety have signed and sealed this bond the

_____ day of _____ , 20____ .

SIGNED AND SEALED
in the presence of:

_____
(Witness as to Principal if no seal)

_____
(Name of Principal)

Per: _____ (Seal)

Per: _____

_____
(Name of Surety)

By: _____ (Seal)
(Attorney-in-Fact)

FORM H2: IRREVOCABLE STANDBY LETTER OF CREDIT
(PERFORMANCE SECURITY)
(See D10)

_____
(Date)

The City of Winnipeg
Internal Services Department
Legal Services Division
185 King Street, 3rd Floor
Winnipeg MB R3B 1J1

RE: PERFORMANCE SECURITY - BID OPPORTUNITY NO. 837-2009

SEWPCC ELECTRICAL INSPECTION AND UPGRADES

Pursuant to the request of and for the account of our customer,

_____ ,
(Name of Contractor)

_____
(Address of Contractor)

WE HEREBY ESTABLISH in your favour our irrevocable Standby Letter of Credit for a sum not exceeding in the aggregate

_____

_____ Canadian dollars.

This Standby Letter of Credit may be drawn on by you at any time and from time to time upon written demand for payment made upon us by you. It is understood that we are obligated under this Standby Letter of Credit for the payment of monies only and we hereby agree that we shall honour your demand for payment without inquiring whether you have a right as between yourself and our customer to make such demand and without recognizing any claim of our customer or objection by the customer to payment by us.

The amount of this Standby Letter of Credit may be reduced from time to time only by amounts drawn upon it by you or by formal notice in writing given to us by you if you desire such reduction or are willing that it be made.

Partial drawings are permitted.

We engage with you that all demands for payment made within the terms and currency of this Standby Letter of Credit will be duly honoured if presented to us at:

_____
(Address)

and we confirm and hereby undertake to ensure that all demands for payment will be duly honoured by us.

All demands for payment shall specifically state that they are drawn under this Standby Letter of Credit.

Subject to the condition hereinafter set forth, this Standby Letter of Credit will expire on

_____ .
(Date)

It is a condition of this Standby Letter of Credit that it shall be deemed to be automatically extended from year to year without amendment from the present or any future expiry date, unless at least 30 days prior to the present or any future expiry date, we notify you in writing that we elect not to consider this Standby Letter of Credit to be renewable for any additional period.

This Standby Letter of Credit may not be revoked or amended without your prior written approval.

This credit is subject to the Uniform Customs and Practice for Documentary Credit (1993 Revision), International Chamber of Commerce Publication Number 500.

_____
(Name of bank or financial institution)

Per: _____
(Authorized Signing Officer)

Per: _____
(Authorized Signing Officer)

PART E - SPECIFICATIONS

GENERAL

E1. APPLICABLE SPECIFICATIONS AND DRAWINGS

E1.1 These Specifications shall apply to the Work.

E1.2 The following Drawings are applicable to the Work.

Drawing No.	Drawing Name/Title
1-0102A-B0001	Facility Floor Plan- Lower Level
1-0102A-B0002	Facility Floor Plan- Main Level
1-0102M-E0006	Plan Layout- Administration Building Electrical Room (MCC-1M)
1-0102M-E0007	Single Line Diagram- Administration Building
1-0102M-E0008	MCC Elevation & Schedule- MCC-1M
1-0102G-E0007	Plan Layout- Grit Building Electrical Room (MCC-1G to 4G, ATS & VFD)
1-0102G-E0008	Single Line Diagram- Pump & Screen Building
SEP-829	Motor Control Centre- 1G
SEP-830	Motor Control Centre- 2G
SEP-831	Motor Control Centres 3G & 4G
SEP-832	MCC-1G &2G and MCC-3G & 4G Distribution Section Schedules
1-0102G-A0002	P & ID- Raw Sewage Pump G101-RSP
1-0102G-A0003	P & ID- Raw Sewage Pump G102-RSP
1-0102G-A0004	P & ID- Raw Sewage Pump G103-RSP
1-0102G-A0005	P & ID- Raw Sewage Pump G104-RSP
1-0102G-A0036	P & ID- 1600A Automatic Transfer Switch G311-ATS
1-0102G-A0037	P & ID- Electrical Distribution and Monitoring (MCC-1G/2G)
1-0102G-A0039	Loop Diagram- Raw Sewage Pump G101
1-0102G-A0038	Loop Diagram- Raw Sewage Pump G102
SEP-2015	Loop Diagram- Raw Sewage Pump G103
SEP-2019	Loop Diagram- Raw Sewage Pump G104
1-0102G-A0040	Loop diagram- MCC-1G & MCC-2G Voltage Alarms
1-0102B-E0006	Plan Layout- Service Building Electrical Room and Generator Room (MCC-2B)
1-0102B-E0007	Single Line Diagram- Service Building
SEP-908	Motor Control Centre- 2B
1-0102P-E0009	Plan Layout- Primary Clarifier Electrical and Control Room (MCC-1P & 2P)
1-0102P-E0010	Single Line Diagram- Primary Clarifier
SEP-288	Motor Control Centre - 1P
SEP-289	Motor Control Centre - 2P
SEP-290	MCC Tie Schedule (MCC- 1P & MCC- 2P)
1-0102P-A0039	P & ID- Electrical Distribution (MCC-1P/2P)
1-0102P-A0040	Loop Diagram- MCC-1P & MCC-2P Voltage Alarms
1-0102R-E0007	Plan Layout- Oxygen Reactors Electrical Distribution (MCC- 1R & 2R)
1-0102R-E0006	Single Line diagram- Oxygen Reactors
SEP-351	Motor Control Centre - 1R
SEP-352	Motor Control Centre – 2R
1-0102S-E0012	Plan layout- Secondary Clarifier Electrical Room (MCC-1S, 2S, Main switchgear)
1-0102S-E0013	Single Line Diagram- Main Electrical Distribution
1-0102S-E0014	Single Line Diagram- Secondary Clarifiers
1-0102S-E0015	Three Line Diagram (Banks 1&2 Main Breakers)
1-0102S-E0016	Breaker Control Schematic (Banks 1 & 2 Main Breakers)
1-0102S-E0017	Panel Layout- Facility Main Breaker Remote Control (DCP-S10)
SEP-453	Switchgear & Details (4000A, 600V Main Switchgear)
SEP-465	Motor Control Centre- 1S Schedule
SEP-466	MCC- 1S & MCC- 2S Panel Layout
SEP-467	Motor Control Centre - 2S Schedule
SEP-468	MCC-1S & MCC- 2S Switchgear Layout & Schematic
1-0102S-A0051	P & ID- Electrical Supply (4000A, 600V Main Switchgear)

1-0102S-A0052 P & ID- Electrical Distribution (MCC-1S/2S)
1-0102S-A0054 Loop Diagram- MCC-1S & MCC-2S Voltage Alarms
1-0102U-E0003 Plan Layout- UV Disinfection Facility Electrical Room (CDP-A, PNL-B, PNL-C)
1-0102U-E0004 Single Line diagram- UV Disinfection

E1.3 The following documents are applicable to the work:

Document No.	Document Name/Title
837-2009_Inspection_Forms	Inspection Forms

E2. HAZARDOUS MATERIALS

E2.1 If asbestos or other hazardous materials are encountered during the Work of the Contract, the Contractor shall stop all work and notify the Contract Administrator immediately. Removal of hazardous materials shall be dealt with by the City and the Contractor shall await further instruction by the Contract Administrator.

E3. LOCATION AND ACCESS TO FACILITIES

E3.1 The Work specified hereinafter will take place at the SEWPCC, located at 100 Ed Spencer Drive Winnipeg, MB, R2N 4G3.

E3.2 Access to the facility will be between 7:45 am and 3:45 pm, Monday to Friday.

E3.3 Additional details and requirements regarding facility access will be provided to the Contractor. The Contractor must comply with all City policies set forth in this document, and detailed instructions provided after the Work is awarded.

E4. SERVICE REQUIREMENTS

E4.1 The Contractor shall provide all services in accordance with the requirements hereinafter specified.

E4.2 All material and equipment required for the inspection, and testing shall also be supplied by the Contractor.

E4.3 All travel and living expenses associated with the services of the personnel defined above are to be included.

E4.4 The Contractor shall meet the following requirements:

(a) a Professional Engineer on staff who is experienced with electrical switchgear and electrical distribution equipment to design repairs or at least written confirmation that they have a suitable engineer on retainer who will provide immediate service if required;

(b) as a minimum, an electrical technologist with experience maintaining, testing, and trouble-shooting switchgear and electrical distribution equipment.

E4.5 All parties involved must be cognisant of industry-standard safety procedures. It is recognized that an overwhelming majority of the tests and inspections recommended in these specifications are potentially hazardous. Individuals performing these tests shall be capable of conducting the tests in a safe manner and with complete knowledge of the hazards involved. All tests shall be performed with the apparatus de-energized and grounded except where otherwise specifically required to be ungrounded or energized for certain tests.

E4.6 The facilities related to the Work are critical to the treatment of wastewater for the City of Winnipeg. Under no condition shall the electrical distribution system be shut down without prior permission of the Contract Administrator. Similarly, coordination and approval are required prior to returning the equipment back into service. Detailed shutdown schedules will be prepared in conjunction with the Contract Administrator. The Contractor shall work within the schedule and

any procedures given, and shall advise the Contract Administrator of any issues or concerns, prior to performing the Work.

E4.7 All required Manitoba Hydro services will be arranged and scheduled by the Contract Administrator and paid directly by the City and shall not be included in the Bid Price

E4.8 The Work shall be scheduled and performed such that there is minimal disturbance to SEWPCC plant operation while the Switchgear is out of service at a given time. In addition, the inspection on each item shall be performed in a manner to reasonably minimize the amount of time to return the switchgear to service, if a work stoppage is required. Under no condition shall both banks of switchgear be out of service at the same time.

E5. TEST EQUIPMENT

E5.1 All test equipment shall meet the requirements in E5.5 and be in good mechanical and electrical condition.

E5.2 Field test metering used to check power system meter calibration must be more accurate than the instrument being tested.

E5.3 Accuracy of metering in test equipment shall be appropriate for the test being performed.

E5.4 Wave shape and frequency of test equipment output waveforms shall be appropriate for the test and the tested equipment.

E5.5 The test equipment shall be calibrated as specified below:

(a) The testing organization shall have a calibration program which assures that all applicable test instruments are maintained within rated accuracy for each test instrument calibrated.

(b) The firm providing calibration service shall maintain up-to-date instrument calibration instructions and procedures for each test instrument calibrated.

(c) Instruments shall be calibrated in accordance with the following frequency schedule:

(a) Field instruments: Analog, 6 months maximum. Digital, 12 months maximum.

(b) Laboratory instruments: 12 months maximum.

(c) Leased specialty equipment: 12 months maximum.

(d) Dated calibration labels shall be visible on all test equipment.

(e) Records, which show date and results of instruments calibrated or tested, must be kept up-to-date.

(f) Calibrating standard shall be of higher accuracy than that of the instrument tested.

E6. INSPECTION AND TEST REPORTS

E6.1 The Contractor shall prepare an overall inspection and test report that details all investigations and tests in conformance with E6.6.

(a) The report shall be divided into sections by plant process area.

E6.2 The Contractor shall furnish five paper copies and two electronic copies on CD of each final report.

(a) The electronic copies of the report, including the test forms, shall be provided in PDF format.

(b) The Microsoft Word version of the all completed test forms provided to the Contractor shall also be included on the CDs.

E6.3 The report shall be neat and organized. Any omissions, inconsistencies, or incomplete work identified by the Contract Administrator shall be corrected and incorporated into the report in the appropriate section, and completely resubmitted as defined in E6.2.

E6.4 A draft of each report shall be completed and sent to the Contract Administrator for review a maximum of one month after the completion of the inspections at the Site.

E6.5 The final report shall be submitted, as defined in E6.2, a maximum of two weeks after the Contractor receives the mark-up of the draft report from the Contract Administrator.

E6.6 The report shall include the following:

(a) Summary of project.

(b) Testing Equipment.

(a) Detail the type, manufacturer, model, and last calibration date of all testing equipment.

(c) Description of equipment tested.

(d) Description of all tests.

(e) Typed inspection forms including:

(a) Identification of the testing organization.

(b) Equipment identification.

(c) Humidity, temperature, and other conditions that may affect the results of the tests/calibrations.

(d) Date of inspections, tests, maintenance, and/or calibrations.

(e) Identification of the testing technician.

(f) Indication of inspections, tests, maintenance, and/or calibrations performed and recorded, along with charts, and graphs as applicable. All measurements and readings taken shall be noted for inclusion in the report. Where repairs are made, measurements and readings before and after the repair shall be included.

(g) Indication of expected results, when calibrations are to be performed.

(h) Indication of “as-found” and “as-left” results, as applicable.

(f) Itemized list of all repaired deficiencies which shall include:

(a) Detailed description of the deficiency.

(b) The cost associated with the deficiency repair.

(g) Itemized list of all un-repaired deficiencies encountered which shall include:

(a) Detailed description of the deficiency.

(b) Priority level.

(c) A cost estimate to repair the deficiency including the estimated hours to repair, labour cost, and material costs.

(h) Analysis and recommendations.

(i) Mark-ups of drawings.

E7. SCHEDULING

E7.1 The Contractor shall provide information, and assist the Contract Administrator, in preparing schedules for the Work.

E7.2 Portions of the Work will be subject to the availability of Manitoba Hydro to perform supply disconnection, open metering enclosures, disconnect metering PTs, and other services as required. Manitoba Hydro’s involvement will be coordinated by the Contract Administrator.

E7.3 It is possible that equipment failure within the SEWPCC could cause an event where the equipment under inspection is immediately required. The City, upon their sole discretion, may delay or stop the Work at any time, require the Contractor to return all or specified electrical equipment into service as soon as possible, and reschedule the Work. The contractor shall be eligible for incremental services, as specified in E9.

E7.4 Expected Operation During Inspections

(a) The SEWPCC facility operates continuously and a complete shutdown of certain processes is not typically possible. Many areas of the plant have redundant systems fed from separate electrical distribution banks. It is expected that only one of the two electrical banks will be shut down at one time. Detailed coordination with the Contract Administrator and City will be required.

E8. REPAIR SERVICES

E8.1 It is expected that the inspection work will identify issues for correction and repair. The Contractor shall include all issues found during the inspections in the inspection report.

E8.2 If the correction/repair is determined to be critical to the immediate operation of the facility then the Contractor shall report the issue immediately to the Contract Administrator.

E8.3 The Contractor shall provide a quotation for repair services for each deficiency found. Individual prices shall be provided for each deficiency, with separate labour prices and individual material costs.

(a) The price for material shall be the Contractor base cost, as defined in B9.4, multiplied by the mark-up factor specified in Form B, Item 14. The mark-up factor shall be between 1.00 and 1.50. In the event that a mark-up factor greater then 1.50 is indicated, 1.50 will be utilized for bid evaluation and payment.

(b) A price for labour shall be provided for each deficiency. Each price shall be stated in number of hours multiplied by the labour rate specified in Form B, Item 15. The rate shall be inclusive of any potential overtime or night-time work that may be required.

E8.4 The Contractor shall provide repair services for each deficiency approved by the Contract Administrator, as quoted in E8.3

E8.5 Repair services shall be comprised of the following:

(a) Provision of shop drawing detailing the work, where modifications are made.

(b) Attendance at a site planning meeting to develop shutdown planning, coordination, and scheduling.

(c) Repair of the deficiency.

(d) Re-inspect the repaired equipment as prescribed in the applicable section of E8.

(e) Provide a supplemental report of the repair services performed, including inspection values and results obtained both prior to, and subsequent to the repair work. Include as-built shop drawings.

E8.6 The City reserves the right to request quotes from other contractors where the quotation to repair defective components is excessive, in the opinion of the Contract Administrator.

E8.7 Cleaning of equipment, tightening of bolted connections, lubrication of mechanical mechanisms and other standard maintenance tasks are to be included as part of the Work and will be addressed immediately by the Contractor during the inspections and included in the Bid Price. These items are not considered to be repair services.

E9. INCREMENTAL SERVICES

E9.1 Additional on-site service time may be necessitated due to unforeseen circumstances that may arise during the course of the project such as:

(a) Unforeseen work stoppages due to inclement weather or equipment failure. The City may, upon their sole discretion, delay or stop the Work at any time, and require the Contractor to return all or specified electrical equipment into service as soon as possible. Charges for incremental services are restricted to the extra services required as a result of the work stoppage. For cases were the Contractor is not yet on site, no incremental services may

be charged for scheduling changes where at least 24 hours notice is given prior to the Contractor's scheduled time to be on site.

(b) Repair services as described in E8.

(c) Additions by the Contract Administrator to the scope of Work, beyond that are defined herein.

E9.2 Additional services are to be paid on an hourly basis at rates specified on Form B.

(a) Labour rates identified are to include the use of the following equipment:

(i) Insulation resistance testing equipment.

(ii) DC overpotential testing equipment.

(iii) Clamp-on grounding tester.

(iv) Any other testing equipment required, that is not specifically identified in Form B.

(b) The rate specified in Form B shall be inclusive of any potential overtime or night-time work that may be required.

E9.3 Additional services will not be initiated for reasons of lack of performance or errors in execution.

E10. INSPECTION, TESTING AND MAINTENANCE SCOPE OF WORK

E10.1 Perform all inspections in accordance with E13 through E38.

E10.2 Perform a thermographic survey, as per E37 and E12, which shall include the following switchgear and equipment:

(a) SGR-S1 and SGR-S2, 4000A, 600V Main Switchgear, all feeders and bus, except the incoming main breakers.

(b) SGR-S1 and SGR-S2 Incoming Busway.

(c) MCC-1M, all feeders, starters and bus.

(d) MCC-1M feeder cable terminations

(e) XFMR-1D.

(f) XFMR-10A.

(g) MCC-1G & MCC-2G, all feeders, starters and bus.

(h) MCC-3G & MCC-4G, all feeders, starters and bus.

(i) MCC-1G & MCC-2G Feed Busway.

(j) MCC-3G & MCC-4G Feed Busway.

(k) XFMR-1G.

(l) XFMR-3G.

(m) XFMR-6G.

(n) XFMR-8G.

(o) GCP-5/ATS 1000A Busway.

(p) ATS/MCC-3G 1600A Busway.

(q) 1000kW Generator ATS.

(r) 1000kW Generator Main Breaker.

(s) 1000kW Generator Terminals.

(t) G101-RSP VFD.

(u) G102-RSP VFD.

(v) G103-RSP VFD.

(w) G104-RSP VFD. Note: This motor is currently out of service, and may remain out of service during the initial portion of the work. Schedule this work for a later period and coordinate with the Contract Administrator as required.

(x) G101-RSP AC motor.

(y) G102-RSP AC motor.

(z) G103-RSP AC motor. Note: This motor is currently out of service, and may remain out of service during the initial portion of the work. Schedule this work for a later period and coordinate with the Contract Administrator as required.

(aa) G104-RSP AC motor.

(bb) MCC-2B, all feeders, starters and bus.

(cc) MCC-2B Feed Busway.

(dd) XFMR-1B.

(ee) XFMR-3B/5B.

(ff) XFMR-7B.

(gg) 85kW Generator ATS.

(hh) 85kW Generator Main Breaker.

(ii) 85kW Generator Terminals.

(jj) CDP-E1.

(kk) MCC-1P & MCC-2P, all feeders, starters and bus.

(ll) MCC-1P & MCC-2P Feed Busway.

(mm) XFMR-1P.

(nn) XFMR-3P.

(oo) XFMR-5P.

(pp) XFMR-6P.

(qq) MCC-1R & MCC-2R, all feeders, starters and bus.

(rr) MCC-1R & MCC-2R Feed Busway.

(ss) XFMR-2R.

(tt) R319-AC motor.

(uu) R340-AC motor.

(vv) MCC-1S & MCC-2S, all feeders, starters and bus.

(ww) MCC-1S & MCC-2S Feed Busway.

(xx) CDP-E2.

(yy) XFMR-2S.

(zz) XFMR-4S.

(aaa) XFMR-5S.

(bbb) XFMR-56C.

(ccc) XFMR-6S.

(ddd) CDP-A (UV disinfection), all feeders, starters and bus.

(eee) CDP-A Feeder Cable terminations.

(fff) XFMR-T1 (UV disinfection).

(ggg) XFMR-T2 (UV disinfection).

E10.3 Perform point-to-point grounding/bonding resistance checks between the major electrical equipment as specified in E36. Measurements to include:

(a) SGR-S1/S2 to MCC-1M.

(b) SGR-S1/S2 to Admin Building PNL-1A.

(c) SGR-S1/S2 to Admin Building Control Room Ground Bus Panel.

(d) SGR-S1/S2 to MCC-1G/2G.

(e) SGR-S1/S2 to MCC-3G/4G.

(f) SGR-S1/S2 to Grit Building Electrical Room Ground Bus Panel.

(g) SGR-S1/S2 to 1000 kW Generator ATS.

(h) SGR-S1/S2 to 1000 kW Generator.

(i) SGR-S1/S2 to 1000 kW Generator Main Breaker.

(j) SGR-S1/S2 to MCC-2B.

(k) SGR-S1/S2 to Boiler Room Water Main Ground.

(l) SGR-S1/S2 to MCC-1P/2P.

(m) SGR-S1/S2 to Primary Clarifier Control Room Ground Bus Panel.

(n) SGR-S1/S2 to MCC-1R/2R.

(o) SGR-S1/S2 to MCC-1S/2S.

(p) SGR-S1/S2 to Secondary Clarifier Control Room Ground Bus Panel.

(q) SGR-S1/S2 to CDP-A (UV Disenfection).

(r) SGR-S1/S2 to UV-Disenfection Ground Bus

(s) SGR-S1/S2 to XFMR-T1 (UV Disenfection).

E10.4 Perform an inspection and test of SGR-S1 and SGR-S2, the 600 V main switchgear, as specified in E16, which includes the following switchgear components:

(a) Main Incoming Busway, Bank 1 and Bank 2. Coordination with Manitoba Hydro will be required.

(b) Two (2) 4000A main breakers (ACB) as specified in E29,

(c) One (1) 4000A tie breaker (ACB) as specified in E29,

(d) Twelve (12) feeder breakers (ACB) as specified in E29,

(e) associated protection relays as specified in E24.

(f) Sequence work to minimize outage time to MCC-2B and CDP-A.

E10.5 Perform an inspection and test of the following equipment associated with the Admin Building:

(a) MCC-1M feeder.

(b) MCC-1M and associated main breakers, starters and feeder breakers.

(i) Starters (9)

(ii) Breakers (9)

(c) XFMR-1D feeder cable & transformer.

(d) PNL-1D feeder cable & panelboard.

(e) XFMR-10A feeder cable & transformer.

(f) PNL-10A feeder cable & panelboard.

(g) PNL-1X feeder cable & panelboard.

(h) PNL-1C feeder cable & panelboard.

(i) PNL-1B feeder cable & panelboard.

(j) PNL-1A feeder cable & panelboard.

E10.6 Perform an inspection and test of the following equipment associated with the Grit Building:

(a) MCC-1G Feed Busway.

(b) MCC-1G, including associated main breaker, starters and feeder breakers.
  (i) Starters (15)
  (ii) Feeder Breakers (11)
  (iii) Capacitors (3)

(c) XFMR-3G feeder cable & transformer.

(d) PNL-3G feeder cable & panelboard.

(e) XFMR-1G feeder cable & transformer.

(f) PNL-1G feeder cable & panelboard.

(g) MCC-2G Feed Busway.

(h) MCC-2G, including associated main breaker, starters and feeder breakers.
  (i) Starters (13)
  (ii) Feeder Breakers (10)
  (iii) Capacitors (4)

(i) MCC-1G/2G tie breaker.

(j) PNL-4G feeder cable & panelboard.

(k) PNL-2G feeder cable & panelboard.

(l) MCC-3G Feed Busway.

(m) MCC-3G, including associated main breaker, starters and feeder breakers.
  (i) Starters (5)
  (ii) Feeder Breakers (8)
  (iii) Capacitors (1)

(n) XFMR-6G feeder cable & panelboard.

(o) PNL-6G feeder cable & panelboard.

(p) G102-RSP VFD feeder cable.

(q) G102-RSP VFD.

(r) G102-RSP motor feeder cable.

(s) G102-RSP motor.

(t) G104-RSP VFD feeder cable.

(u) G104-RSP VFD.

(v) G104-RSP motor feeder cable.

(w) G104-RSP motor.

(x) MCC-4G Feed Busway.

(y) MCC-4G, including associated main breaker, starters and feeder breakers.
  (i) Starters (1)
  (ii) Feeder Breakers (6)
  (iii) Capacitors (1)

(z) G101-RSP VFD feeder cable.

(aa) G101-RSP VFD.

(bb) G101-RSP motor feeder cable.

(cc) G101-RSP motor.

(dd) G103-RSP VFD feeder cable.

(ee) G103-RSP VFD. Note: This motor is currently out of service, and may remain out of service during the initial portion of the work. Schedule the operational portions of the work for a later period and coordinate with the Contract Administrator as required.

(ff) G103-RSP motor feeder cable.

(gg) G103-RSP motor.

(hh) MCC-3G/4G tie breaker.

(ii) 1000 kW generator ATS.

(jj) 1000 kW generator Main Breaker.

(kk) 1000 kW generator.

(ll) 1000 kW generator cable.

(mm) GCP-5/ATS 1000A Busway.

(nn) ATS/MCC-3G 1600A Busway.

(oo) Verify the operation of the associated DCS status and alarm points. The assistance of City personnel will be required. Specific points to be tested are:

Point	Type	Description
SA-G551-ET	AI	MCC-1G Voltage
SA-G552-ET	AI	MCC-2G Voltage
SA-G553-ET	AI	MCC-3G Voltage
SA-G554-ET	AI	MCC-4G Voltage
SA-G555-EA	DI	MCC-1G Voltage Alarm
SA-G556-EA	DI	MCC-2G Voltage Alarm
SA-G301-ET	AI	Generator (1000kW) Voltage
SA-G301-MM	DI	Generator (1000kW) Running
SA-G301-QF	DI	Generator (1000kW) Fail
SA-G301-YS	DI	Generator (1000kW) in Auto
SA-G309-ZB	DI	Generator (1000kW) Breaker Closed
SA-G309-ZD	DI	Generator (1000kW) Breaker Open
SA-G311-ZB	DI	G311-ATS in Normal Position
SA-G311-ZD	DI	G311-ATS in Emergency Position
SA-G311-YS	DI	G311-ATS in Auto
SA-G305-ZB	DI	MCC-4G Breaker Closed
SA-G305-ZD	DI	MCC-4G Breaker Open
SA-G306-ZB	DI	MCC-3G Breaker Closed
SA-G306-ZD	DI	MCC-3G Breaker Open
SA-G308-ZB	DI	MCC-3G/4G Tie Breaker Closed
SA-G308-ZD	DI	MCC-3G/4G Tie Breaker Open

E10.7 Perform an inspection and test of the following equipment associated with the Service Building:

(a) MCC-2B Feed Busway.

(b) MCC-2B, including associated main breaker, starters and feeder breakers.

(i) Starters (34)

(ii) Feeder Breakers (18)

(iii) Capacitors (0)

(c) Capacitor Rack.

(d) XFMR-1B feeder cable & transformer.

(e) PNL-1B feeder cable & panelboard.

(f) XFMR-3B/5B feeder cable & transformer.

(g) PNL-3B feeder cable & panelboard.

(h) PNL-5B feeder cable & panelboard.

(i) XFMR-7B feeder cable & transformer.

(j) PNL-7B feeder cable & panelboard.

(k) 85 kW generator.

(l) 85 kW generator breaker & feeder cable.

(m) 85 kW generator ATS and feeder cables from generator breaker and MCC-2B.

(n) Splitter, 200A, and feeder cable associated with essential power.

(o) CDP-E1 feeder cable and panelboard. For each main and feeder/load breaker, perform an insulation resistance and contact resistance test and complete a separate inspection form.

(p) PNL-4B feeder cable & panelboard.

(q) PNL-2B feeder cable & panelboard.

(r) Verify the operation of the associated DCS status and alarm points. The assistance of City personnel will be required. Specific points to be tested are:

Point	Type	Description
SI-B510-ET	AI	MCC-2B Voltage
SI-B543-MM	DI	Generator (85 kW) Run
SI-B543-QF	DI	Generator (85 kW) Fail
SI-B543-YS	DI	Generator (85 kW) In Auto
SI-B543-ZB	DI	Generator (85 kW) ATS in Generator Pos
SI-B543-ZD	DI	Generator (85 kW) ATS in Normal Pos

E10.8 Perform an inspection and test of the following equipment associated with the Primary Clarifiers:

(a) MCC-1P Feed Busway.

(b) MCC-1P, including associated main breaker, starters and feeder breakers.

(i) Starters (18)

(ii) Feeder Breakers (12)

(iii) Capacitors (3)

(c) XFMR-3X feeder cable & transformer.

(d) PNL-3X feeder cable & panelboard.

(e) XFMR-1P feeder cable & transformer.

(f) PNL-1P feeder cable & panelboard.

(g) XFMR-3P feeder cable & transformer.

(h) PNL-3P feeder cable & panelboard.

(i) XFMR-5P feeder cable & transformer

(j) PNL-5P feeder cable & panelboard.

(k) MCC-2P Feed Busway.

(l) MCC-2P, including associated main breaker, starters and feeder breakers.

(i) Starters (16)
(ii) Feeder Breakers (18)
(iii) Capacitors (3)

(m) MCC-1P/2P tie breaker.

(n) XFMR-2P feeder cable & transformer.

(o) PNL-2P feeder cable & panelboard.

(p) XFMR-4P feeder cable & transformer.

(q) PNL-4P feeder cable & panelboard.

(r) PNL-6P feeder cable & panelboard.

(s) Verify the operation of the associated DCS status and alarm points. The assistance of City personnel will be required. Specific points to be tested are:

Point	Type	Description
SB-P504-ET	AI	MCC-1P Voltage
SB-P505-ET	AI	MCC-2P Voltage
SB-P506-EA	DI	MCC-1P Voltage Alarm
SB-P507-EA	DI	MCC-2P Voltage Alarm

E10.9 Perform an inspection and test of the following equipment associated with the Reactors:

(a) MCC-1R Feed Busway.

(b) MCC-1R, including associated main breaker, starters and feeder breakers.
(i) Starters (14)
(ii) Feeder Breakers (5)
(iii) Capacitors (3)

(c) MCC-2R Feed Busway.

(d) MCC-2R, including associated main breaker, starters and feeder breakers.
(i) Starters (16)
(ii) Feeder Breakers (18)
(iii) Capacitors (3)

(e) MCC-1R/2R tie breaker.

(f) XFMR-2R feeder cable & transformer.

(g) PNL-2R feeder cable & panelboard.

(h) Verify the operation of the associated DCS status and alarm points. The assistance of City personnel will be required. Specific points to be tested are:

Point	Type	Description
SD-R505-ET	AI	MCC-1R Voltage
SD-R506-ET	AI	MCC-2R Voltage

E10.10 Perform an inspection and test of the following equipment associated with the Secondary Clarifiers:

(a) MCC-1S Feed Busway.

(b) MCC-1S, including associated main breaker, starters and feeder breakers.
(i) Starters (34)
(ii) Feeder Breakers (11)

(iii) Capacitors (4)

(c) XFMR-5S feeder cable & transformer.

(d) PNL-5S feeder cable & panelboard.

(e) XFMR-56C feeder cable & transformer.

(f) PNL-56C feeder cable & panelboard.

(g) PNL-3S feeder cable & panelboard.

(h) PNL-1S feeder cable & panelboard.

(i) MCC-2S Feed Busway.

(j) MCC-2S, including associated main breaker, starters and feeder breakers.

(i) Starters (29)

(ii) Feeder Breakers (15)

(iii) Capacitors (4)

(k) MCC-1S/2S tie breaker.

(l) CDP-E2 feeder cable & panelboard. For each main and feeder/load breaker, perform an insulation resistance and contact resistance test and complete a separate inspection form.

(m) XFMR-4S delay contactor, feeder cables & transformer. Inspect contactor utilizing motor starter requirements specified in E26.

(n) PNL-4S feeder cable & panelboard.

(o) XFMR-2S delay contactor, feeder cables & transformer. Inspect contactor utilizing motor starter requirements specified in E26.

(p) PNL-2S feeder cable & panelboard.

(q) XFMR-6S feeder cable & transformer.

(r) PNL-6S feeder cable & panelboard.

(s) Verify the operation of the associated DCS status and alarm points. The assistance of City personnel will be required. Specific points to be tested are:

Point	Type	Description
SF-S511-ET	AI	MCC-1S Voltage
SF-S512-ET	AI	MCC-2S Voltage
SF-S513-EA	DI	MCC-1S Voltage Alarm
SF-S514-EA	DI	MCC-2S Voltage Alarm

E10.11 Perform an inspection and test of the following equipment associated with the UV Disinfection Building:

(a) CDP-A feeder cable, including visual inspection and torque check of junction boxes.

(b) CDP-A, including associated main breaker and feeder breakers.

(c) XFMR-T1 feeder cable & transformer. Note that XFMR-T1 is a liquid filled transformer.

(d) PNL-B feeder cable & panelboard.

(e) XFMR-T2 feeder cable & transformer.

(f) PNL-C feeder cable & panelboard.

E10.12 Perform a harmonics measurement, in accordance with E38 at the following locations:

(a) SGR-S1.

(i) Coordinate with City to ensure that Raw Sewage Pumps G104-RSP and G102-RSP are running with varying loads.

(b) SGR-S2.

(i) Coordinate with City to ensure that Raw Sewage Pumps G101-RSP and G103-RSP are running with varying loads.

(c) MCC-3G.

(i) Coordinate with City to ensure that Raw Sewage Pumps G102-RSP and G104-RSP are running with varying loads.

(d) MCC-4G.

(i) Coordinate with City to ensure that Raw Sewage Pumps G101-RSP and G103-RSP are running with varying loads.

E11. CONSTRUCTION SCOPE OF WORK

E11.1 Perform all construction in accordance with E39 through E40.

E11.2 Install a connection to the DCS to provide a voltage alarm for six (6) MCCs. Supply and install all wiring and new conduit. Program / configure the meters to provide the voltage alarm, based on settings provided by the Contract Administrator. Test and commission the operation of the voltage alarm. The following MCCs are included:

(a) MCC-1G.

(b) MCC-2G.

(c) MCC-1P.

(d) MCC-2P.

(e) MCC-1S.

(f) MCC-2S.

E11.3 VFD Standby Power Modifications:

(a) Modify the control wiring of the four (4) raw sewage pumps VFDs as shown on the drawings. Remove the Normal/Emergency selector switch, including any component nameplate, and cover the hole in the panel door with a metal plate or approved hole plug. Plate colour to match existing.

(b) Test and verify the VFD operation on standby power by simulating utility power failure and verifying that the two VFDs on MCC-3G (VFD G101 RSP and VFD G104 RSP) are available to start automatically as soon as standby power is made available to VFD (this is confirmed by start relay (R2 on drawing), picking up and holding itself).

(c) Attend and perform minor wiring adjustments as may be required by SEWPCC to complete the above verification at site.

E11.4 Main Switchgear (SGR-S1 and SGR-S2) Modifications:

(a) Disconnect and remove the 1VM and 2VM protection units (three phase voltage monitor make-SSAC model- WVM 011M) from 600V, 4000A SGR-S1, and from SGR-S2 Breaker control compartments.

(i) Disconnect and remove the 600V voltage monitoring circuit wiring between the fuse block and 1VM/2VM relay (wire is marked as L11A, L12B and L13C) in the two Breaker control compartments.

(ii) Disconnect and remove the trip circuit wires on 1VM and 2VM (wires marked as X1 and TT1) from the terminal strip, ensuring that other connections are maintained and not disturbed.

(iii) Extend 1MC/CT1, 1MC/CT2 terminal groups from their existing positions in Breaker compartment to Low voltage compartment, using new terminal blocks, new wiring.

(b) Supply, install, terminate and test CSA approved, NEMA-12 steel enclosure, remote push button station DCP-S10 (for open/ close breaker control) for the main breakers.

(i) Supply, install and terminate internal and external control wiring and accessories as indicated on the drawings and in compliance with code requirements. Install additional DIN rail, new terminal blocks as required in Breaker control compartment for terminating the new external wiring.

(ii) Test the two breaker controls from the new remote push button stations, for both Bank 1 and Bank 2 feeders. Coordinate with SEWPCC personnel.

(iii) Identify DCP-S10 with lamacoid nameplate. Affix a screwed caution nameplate on each of the breaker low voltage compartments “WARNING - THIS FEEDER CAN BE OPERATED FROM REMOTE CONTROL PANEL DCP-S10”.

(c) Supply and install voltmeters in SGR-S1 and SGR-S2, along with associated PTs, fuses, voltmeter switches, wiring, etc as shown on the drawings.

(i) Procure, supply, install and test switchboard type AC Voltmeters in 0-750V scale, rated AC 120V, 60Hz for the two utility main feeders. The voltmeters shall be mounted flush on the front panel door.

(ii) Procure, supply, install and test voltage selector switches rated 30A, 600V AC, 60Hz for the two utility main feeders. The switches shall be mounted on the front panel door.

(iii) Procure, supply, install and test two units of three-phase, open-delta voltage transformer rated 600V/120V AC, for the two utility main feeders. The transformers shall be mounted inside the low voltage control compartments on each feeder.

(iv) Procure supply and install primary and secondary fuses for the voltage transformers, in suitable ratings as recommended by the manufacturer. If the existing primary fuse bases are not compatible with the recommended fuses then supply and install new fuse bases compatible with the fuses recommended by the manufacturer.

(v) Procure, supply, install and test control wiring for the above as shown on the drawings.

E12. THERMOGRAPHIC CAMERA

E12.1 Supply one new thermographic camera.

E12.2 The thermographic camera supplied may be utilized to perform the inspection work under this project, and turned over to the City, in “as good as new” condition, upon completion of the work.

E12.3 If a different camera is utilized to perform the required thermographic work, it shall have image specifications that equal or exceed the camera specified below.

E12.4 Payment for the camera will be upon turnover to the City. Should there be any defects, misuse, or any cause to believe that the camera is not in “as good as new” condition, the City reserves the right to reject the camera.

E12.5 Thermographic Camera Requirements:

(a) Field of View: 25° x 19°.

(b) Close Focus Limit: 0.4m.

(c) Thermal Sensitivity: 60 mK @ + 30°C.

(d) Detector Type: Focal Plane Array, microbolometer

(e) IR Resolution: 320 x 240 pixels

(f) Spectral Range: 7.5 to 13 µm.

(g) Digital Zoom: 1-8x continuous.

(h) Focus: Auto and manual.

(i) IFOV: 1.36 mRad.

(j) Image Presentation: Thermal & Visual.

(k) Picture in Picture Feature, movable and resizable smaller picture.

(l) Thermal fusion feature to merge thermal and visual image.

(m) Display: Touch-screen LCD display, 3.5".

(n) Voice annotation feature.

(o) Text from soft keys feature.

(p) Sketch feature.

(q) Image markers on IR or visual feature.

(r) Video lamp: 1000 cd.

(s) Visible Light camera resolution: 1280 x 1024.

(t) Object Temperature Range: -20°C to 120°C and 0°C to 350°C.

(u) Accuracy: +/-2°C or +/-2% of reading.

(v) Spotmeters: 5

(w) Box Areas: 5

(x) Isotherm feature.

(y) Auto hot/cold spot feature.

(z) Image Storage: Removable SD card.

(aa) Battery: Lithion ion

(bb) Battery charger, 120VAC.

(cc) Reporting software.

(i) Standard to acceptance to be FLIR Quickreport.

(dd) Lens: 25°.

(ee) Accessories to include: Transport / Storage case, SD Memory card, Battery charger, USB cable for connection to PC, Video cable, Sun Shield, Stylus Pen, User Documentation,

(ff) Spare Parts:

(i) Extra (2^{nd}) battery.

(gg) Standard of acceptance to be FLIR T400, manufactured by FLIR Systems Inc. Alternative equivalent products require approval.

INPECTION, TESTING AND MAINTENANCE PROCEDURES

E13. GENERAL

E13.1 All tests are based on NETA (InterNational Electrical Testing Association) standard MTE-2005. Where manufacturer's specifications, tolerances, and/or published data are not available, refer to tables 100.1 to 100.22 in MTE-2005.

E13.2 Torque all accessible bolted electrical connections. Additional requirements apply as specified.

E13.3 Utilize the existing drawings for reference while performing the specified electrical inspection work. Where the existing installation deviates from that shown on the drawings, mark-up the drawings with red pen as required to reflect the installation. Include the marked-up drawings shall be included in the report.

(a) The scope of required drawing checks is limited to the equipment and components that are part of the electrical inspection work.

(b) Any repairs made that affect the accuracy of the drawings shall be marked up on the drawings.

(c) Drafting of drawings is not required.

E13.4 All inspection values, readings, corrections, and assessments shall be clearly recorded for inclusion within the report.

E13.5 Where corrections or repairs are made, record both as found/as left test readings on the inspection sheet. If space is not provided on the inspection form, record the readings in the Note fields or on a separate sheet.

E13.6 Inspection Forms

(a) The inspection forms to be completed by the Contractor are provided for reference in PDF format.

(b) Microsoft Word form templates will be provided prior to the work being initiated.

(c) Make appropriate print-outs of the inspection forms and utilize for entry of data and test results on site.

(d) Utilizing the Microsoft Word form templates, enter the data recorded manually into the forms electronically.

(e) Complete the inspection forms in the entirety and include them in the report.

(f) Submit electronic PDF copies of the inspection forms.

(g) The scope of work required in the specifications is in no way limited by the inspection forms, or spaces provided. Provide additional pages, documents, and forms as required to provide a complete report.

(h) The inspection forms may be updated during the Work by the City or Contract Administrator. Utilize the latest forms provided.

E13.7 Perform insulation resistance temperature correction calculations utilizing the following:

(a) To correct to 20°C, utilize Table E11-1.

(b) To correct to 40°C, utilize Table E11-2.

Table E11-1 Insulation Resistance Correction Factors (20 °C)		
Measured Temperature (°C)	**Oil Immersed Insulation**	**Solid Insulation**
-10	0.125	0.25
-5	0.18	0.32
0	0.25	0.40
5	0.36	0.50
10	0.50	0.63
15	0.75	0.81
16	0.80	0.85
17	0.85	0.89
18	0.90	0.92
19	0.95	0.96
20	1.00	1.00
21	1.08	1.05
22	1.16	1.10
23	1.24	1.15
24	1.32	1.20
25	1.40	1.25
30	1.98	1.58
35	2.80	2.00
40	3.95	2.50
45	5.60	3.15
50	7.85	3.98
55	11.20	5.00
60	15.85	6.30

Table E11-2 Insulation Resistance Correction Factors (40 °C)		
Measured Temperature (°C)	**Oil Immersed Insulation**	**Solid Insulation**
-10	0.03	0.10
-5	0.04	0.13
0	0.06	0.16
5	0.09	0.20
10	0.13	0.25
15	0.18	0.31
16	0.19	0.33
17	0.21	0.34
18	0.22	0.36
19	0.24	0.38
20	0.25	0.40
21	0.27	0.42
22	0.29	0.44
23	0.31	0.46
24	0.33	0.48
25	0.35	0.50
30	0.50	0.63
35	0.71	0.79
40	1.00	1.00
45	1.41	1.26
50	2.00	1.59
55	2.83	2.00
60	4.00	2.52

E13.8 Perform winding resistance temperature correction calculations utilizing the following:

(a) $$R_C = R_M \frac{T_C + T_K}{T_M + T_K}$$

(b) Where, R_C = Resistance at corrected temperature.
R_M = Resistance at measured temperature.
T_C = Temperature to correct to in °C.
T_M = Measured temperature in °C.
T_K = Temperature Resistance Constant
(234.5 °C for copper, 226.0 °C for aluminum)

E14. CABLES, < 1000 V (ALSO FEEDERS IN CONDUIT)

Inspection and testing shall be comprised of the following:

(a) Inspect exposed sections of cables/wires for physical damage and evidence of overheating and corona.

(b) Inspect terminations and splices for physical damage and evidence of overheating and corona.

(c) For cables/wires 4/0 AWG or larger, inspect bolted electrical connections for high resistance using a low-resistance ohmmeter. Compare bolted connection resistance values to values of similar connections. Investigate values which deviate from those of similar bolted connections by more than 50 percent of the lowest value.

(d) Torque all accessible bolted electrical connections.

(e) Inspect compression applied connectors for correct cable match and indentation.

(f) Inspect grounding and cable/conduit support.

(g) Verify that visible cable bends meet or exceed the minimum allowable bending radius.

(h) Measure length of cable/conduit and record in meters.

(i) If cables/wires are terminated through window-type current transformers, inspect to verify that neutral and ground conductors are correctly placed and that shields are correctly terminated for operation of protective devices.

(j) Perform an insulation-resistance test on each conductor. Individually test each conductor with all other conductors and shields grounded. The test duration shall be one minute. Investigate resistances less than 1000 megaohms. The voltage applied shall be 500 Vdc for 300 V rated cables, and 1000 Vdc for 600 V or 1000 V rated cables.

E15. BUSWAY, <1000V

E15.1 Inspection and testing of low voltage busway shall be comprised of the following:

(a) Inspect end sections of busway and bends for any physical damage and evidence of overheating. Inspect bends for any thermo mechanical stresses and insulator stressing.

(b) Inspect anchorage, alignment, and grounding.

(c) Confirm physical orientation in accordance with manufacturer’s labels to insure adequate cooling.

(d) Examine outdoor busway for removal of “weep-hole” plugs, if applicable, and for the correct installation of joint shield.

(e) Inspect and clean ventilating openings.

(f) Verify operation of busway heaters.

(g) Inspect end termination and tap bolted electrical connections for high resistance using one of the following methods:

  (i) Use of a low resistance ohmmeter to measure resistance through bolted connections.

  (ii) Verify tightness of accessible bolted electrical connections and bus joints by calibrated torque-wrench method.

(h) Inspect busway grounding and support system.

(i) Perform an insulation-resistance test on each phase conductor. Individually test each conductor with all other conductors and shields grounded. The test duration shall be one minute. Investigate resistances less than 1000 megaohms. The voltage applied shall be 500 Vdc for busway rated 300 V or less, and 1000 Vdc for 600V busway.

(j) Measure the total resistance of the busway on each phase, and the total inductance of the bus on each phase.

(k) Measure the total length of busway centerline.

E16. SWITCHGEAR ASSEMBLIES, 600 V

Inspection and testing shall be comprised of the following:

(a) Inspect the switchgear physical, electrical, and mechanical condition including evidence of moisture or corona.

(b) Verify appropriate anchorage, required area clearances, physical damage, and correct alignment.

(c) Inspect all doors, panels, and sections for dents, holes, fit, and missing hardware.

(d) Verify that fuse and / or circuit breaker sizes and types correspond to drawings and coordination study as well as to the circuit breaker's address for microprocessor-communication packages.

(e) Verify that current and potential transformer ratios correspond to drawings.

(f) Torque all accessible bolted electrical connections.

(g) Perform resistance measurements through bolted connections with a low-resistance ohmmeter. Compare bolted connection resistance values to values of similar connections. Investigate values which deviate from those of similar bolted connections by more than 50 percent of the lowest value.

(h) Confirm correct operation and sequencing of electrical and mechanical interlock systems.

  (a) Attempt closure on locked-open devices. Attempt to open locked-closed devices.

  (b) Make key exchange with all devices included in the interlock scheme as applicable.

(i) Clean switchgear.

(j) Use appropriate lubrication on moving current-carrying parts and on moving and sliding surfaces.

(k) Inspect insulators for evidence of physical damage or contaminated surfaces.

(l) Verify correct barrier and shutter installation and operation.

(m) Exercise all active components.

(n) Inspect all mechanical indicating devices for correct operation.

(o) Verify that filters are in place and / or vents are clear.

(p) Test operation, alignment, and penetration of instrument transformer withdrawal disconnects, current-carrying and grounding contacts.

(q) Perform point to point ground-resistance tests to determine the resistance between the main grounding system and all major electrical equipment frames, system neutral, and / or derived neutral points. Investigate point-to-point resistance values which exceed 0.5 ohm.

(r) Perform insulation-resistance tests at 1000 Vdc for one minute on each bus section, phase-to-phase and phase-to-ground. Flag and investigate any resistance values less than 1,000 megaohms.

(s) Perform an overpotential test on each bus section, each phase-to-ground with phases not under test grounded. Utilize a test voltage of 2000 Vdc unless manufacturer recommendations are lower. The test voltage shall be applied for one minute. Do not perform this test unless insulation resistance tests performed in (r) are higher than the specified minimum value.

  (i) Ensure that all power supplies and load feeders are disconnected/ isolated.

  (ii) Ensure all control devices connected to the bus are isolated or their high voltage withstand values are known and established prior to performing this test.

(t) Perform insulation-resistance tests on control wiring routed in or through power compartments. Perform the test with respect to ground. The applied potential shall be 500 volts dc for 300-volt rated cable and 1000 volts dc for 600-volt rated cable. For units with solid-state components or control devices that cannot tolerate the applied voltage, follow manufacturer's recommendation.

(u) Inspect all capacitors as specified in E28.

(v) Inspect control power transformers as specified in E19.

(w) Inspect all current instrument transformers as specified in E20.

(x) Inspect potential transformers as specified in E21.

(y) Inspect all metering devices as specified in E22 and E23.

(z) Inspect and test protective relays as specified in E24.

(aa) Perform a system function test to prove the correct interaction of all sensing, processing, and action devices. Perform system function tests upon completion of the maintenance tests defined, as system conditions allow.

(a) Develop test parameters and perform tests for the purpose of evaluating performance of all integral components and their functioning as a complete unit within design requirements and manufacturer's published data.

(b) Verify the correct operation of all interlock safety devices for fail-safe functions in addition to design function.

(c) Verify the correct operation of all sensing devices, alarms, and indicating devices.

(bb) Affix an inspection sticker or inspection tag to each switchgear cell in an appropriate place so that it will be conspicuous to all authorized personnel. This inspection notice must include, but is not limited to, equipment identifier, testing company name, date of inspection and the inspector's name. The sticker shall not obscure any equipment nameplates, readouts, or indicators.

E17. MOTOR CONTROL CENTRE AND DISTRIBUTION SWITCHBOARDS, 600 V

Inspection and testing shall be comprised of the following:

(a) Inspect the MCC/switchboard physical, electrical, and mechanical condition including evidence of moisture or corona.

(b) Verify appropriate anchorage, required area clearances, physical damage, and correct alignment.

(c) Inspect all doors, panels, and sections for dents, holes, fit, and missing hardware.

(d) Verify that fuse and / or circuit breaker sizes and types correspond to drawings and coordination study as well as to the circuit breaker's address for microprocessor-communication packages.

(e) Verify that current and potential transformer ratios correspond to drawings.

(f) Perform resistance measurements through bolted connections with a low-resistance ohmmeter. Compare bolted connection resistance values to values of similar connections. Investigate values which deviate from those of similar bolted connections by more than 50 percent of the lowest value.

(g) Confirm correct operation and sequencing of electrical and mechanical interlock systems.

(a) Attempt closure on locked-open devices. Attempt to open locked-closed devices.

(b) Make key exchange with all devices included in the interlock scheme as applicable.

(h) Clean MCC / switchboard.

(i) Use appropriate lubrication on moving current-carrying parts and on moving and sliding surfaces.

(j) Inspect insulators for evidence of physical damage or contaminated surfaces.

(k) Verify correct barrier and shutter installation and operation.

(l) Exercise all active components.

(m) Inspect all mechanical indicating devices for correct operation.

(n) Verify that filters are in place and / or vents are clear.

(o) Test operation, alignment, and penetration of instrument transformer withdrawal disconnects, current-carrying and grounding contacts.

(p) Perform point to point ground-resistance tests to determine the resistance between the main grounding system and all major electrical equipment frames, system neutral, and / or derived neutral points. Investigate point-to-point resistance values which exceed 0.5 ohm.

(q) Perform insulation-resistance tests at 1000 Vdc for one minute on each bus section, phase-to-phase and phase-to-ground.

(r) Inspect all surge arrestors if available, as specified in E18.

(s) Inspect control power transformers as specified in E19.

(t) Inspect all current instrument transformers as specified in E20.

(u) Inspect potential transformers as specified in E21.

(v) Inspect all metering devices as specified in E22 and E23.

(w) Inspect and test air circuit breakers as specified in E29.

(x) Inspect and test protective relays as specified in E24.

(y) Inspect and test all associated motor starters as specified in E26.

(z) Inspect and test all molded case feeder breakers as specified in E30. Feeder breakers with a frame size less than 250A, and without long, short, or ground fault settings, may be recorded on the MCC/Switchboard inspection form. Record test results on other breakers on the appropriate inspection form.

(aa) Inspect and test all capacitors as specified in E28.

(bb) Perform a system function test to prove the correct interaction of all sensing, processing, and action devices. Perform system function tests upon completion of the maintenance tests defined, as system conditions allow.

(i) Perform tests for the purpose of evaluating performance of all integral components and their functioning as a complete unit within each MCC cell.

(ii) Verify the correct operation of all interlock safety devices for fail-safe functions in addition to design function.

(iii) Verify the correct operation of all sensing devices, alarms, and indicating devices.

(cc) Affix an inspection sticker or inspection tag to each MCC line-up or switchboard in an appropriate place so that it will be conspicuous to all authorized personnel. This inspection notice must include, but is not limited to, equipment identifier, testing company name, date of inspection and the inspector's name. The sticker shall not obscure any equipment nameplates, readouts, or indicators.

E18. SURGE ARRESTORS, LOW VOLTAGE

Inspection and testing shall be comprised of the following:

(a) Inspect physical and mechanical condition.

(b) Inspect anchorage, alignment, grounding, and required clearances.

(c) Clean the unit.

(d) Verify that arrestors are electrically connected in their specified configuration.

(e) Perform resistance measurements through bolted connections with a low-resistance ohmmeter. Compare bolted connection resistance values to values of similar connections. Investigate values which deviate from those of similar bolted connections by more than 50 percent of the lowest value.

(f) Verify that the ground lead on each device is individually attached to a ground bus or ground electrode.

(g) Verify that stroke counter, if present, is correctly mounted and electrically connected.

(h) Perform insulation-resistance tests for one minute from each phase terminal to the case.

(i) Equipment rated >= 600V, utilize a test voltage of 1000 VDC.

(ii) Equipment rated < 600V, utilize a test voltage of 500 VDC.

(i) Test the grounding connection. Resistance between the arrester ground terminal and the ground system should be less than 0.5 ohm.

E19. CONTROL POWER TRANSFORMERS, < 1000 V

Inspection and testing shall be comprised of the following:

(a) Record the equipment nameplate data for inclusion in the report.

(b) Inspect physical damage, cracked insulation, broken leads, tightness of connections, defective wiring, and overall general condition.

(c) Verify that primary and secondary fuse ratings or circuit breakers match available drawings. Where drawings are not available, note fuses that appear to be sized incorrectly, based upon application of the Canadian Electrical Code. Mark fuse sizes and type on the drawings, where not shown.

(d) Perform insulation-resistance tests. Perform measurements from winding-to-winding and each winding-to-ground. Test voltages shall be:

(i) windings < 250 V: 500 Vdc

(ii) windings > 250 V: 1000 Vdc

E20. CURRENT INSTRUMENT TRANSFORMERS

Inspection and testing shall be comprised of the following:

(a) Inspect physical and mechanical condition.

(b) Record the equipment nameplate data for inclusion in the report.

(c) Ensure that CT shorting bars are removed or installed as required.

(d) Verify that current circuits are grounded and have only one grounding point in accordance with ANSI/IEEE C57.13.3.

(e) Perform an insulation resistance test of the current transformer primary and secondary windings, and wiring to ground at 1000 Vdc. Do not perform this test on solid-state devices. Investigate any resistance values less than 25 megaohms.

(f) Perform a polarity test of each current transformer in accordance with ANSI/IEEE C57.13.1.

(g) Perform a ratio-verification test using the voltage or current method in accordance with ANSI/IEEE C57.13.1. Note any ratio accuracies not within 0.5% of nameplate or manufacturer's published data.

(h) Perform an excitation test on transformers used for protection or relaying applications in accordance with ANSI C57.13.1.

E21. POTENTIAL TRANSFORMERS, < 1000 V

Inspection and testing shall be comprised of the following:

(a) Record the equipment nameplate data for inclusion in the report.

(b) Inspect physical and mechanical condition.

(c) Verify that all required grounding and shorting connections provide contact.

(d) Verify correct operation of transformer withdrawal mechanism and grounding operation.

(e) Verify correct primary and secondary fuse sizes for potential transformers.

(f) Torque all bolted connections.

(g) Perform an insulation resistance test for winding to winding and winding to ground. Test voltages shall be applied for one minute. Do not perform this test with solid-state devices connected. Investigate any resistance values less than 100 megaohms for 600 V rated windings. Test voltages shall be:

(i) 600 V windings: 1000 Vdc

(ii) 120 V windings: 500 Vdc

(h) Perform a polarity test on each transformer to verify the polarity marks or H1-X1 relationship as applicable.

(i) Perform a turns ratio verification test. Note any ratio accuracies not within 0.5% of the nameplate or manufacturer's published data.

E22. METERING DEVICES, ANALOG

Inspection and testing shall be comprised of the following:

(a) Inspect physical and mechanical condition.

(b) Torque all bolted connections.

(c) Inspect cover gasket, cover glass, condition of spiral spring, disk clearance, contacts, and case-shorting contacts, as applicable.

(d) Clean the unit.

(e) Verify freedom of movement, end play, and alignment of rotating disk(s).

(f) Verify accuracy of meters at a minimum of three points, one of them being 0.

(g) Calibrate meters in accordance with manufacturer's published data.

E23. METERING DEVICES, DIGITAL

Inspection and testing shall be comprised of the following:

(a) Inspect physical and mechanical condition.

(b) Torque all bolted connections.

(c) Record the equipment nameplate data for inclusion in the report.

(d) Verify accuracy of voltage and current at a minimum of two points each.

(e) If required, calibrate meters in accordance with manufacturer's published data.

E24. PROTECTIVE RELAYS

Inspection and testing shall be comprised of the following:

(a) Inspect relays and cases for physical damage.

(b) Clean the unit.

(c) Perform the following to the relay case:

  (a) Tighten case connections.

  (b) Inspect cover for correct gasket seal.

  (c) Clean cover glass. Inspect shorting hardware, connection paddles, and/or knife switches.

  (d) Remove any foreign material from the case.

  (e) Verify target reset.

(d) Perform the following inspection of the relay mechanism:

  (a) Inspect relay for foreign material, particularly in disk slots of the damping and electromagnets.

  (b) Verify disk clearance. Verify contact clearance and spring bias.

  (c) Inspect spiral spring convolutions. Inspect disk and contacts for freedom of movement and correct travel. Verify tightness of mounting hardware and connections. Burnish contacts. Inspect bearings and/or pivots.

(e) Verify that all settings are in accordance with coordination study or setting sheet supplied. Note the value and compliance of each setting for inclusion in the report. Where no setting is provided, note the current protective relay setting value, and identify this setting in the report.

(f) Perform insulation-resistance test on each circuit-to-frame. Procedures for performing insulation-resistance tests on solid-state relays should be determined from the relay manufacturer's published data.

(g) Inspect targets and indicators.
  (a) Determine pickup and dropout of electromechanical targets.
  (b) Verify operation of all light-emitting diode indicators.
  (c) Set contrast for liquid-crystal display readouts.

(h) Verify that each of the relay contacts performs its intended function in the control scheme including breaker trip tests, close inhibit tests, 86 lockout tests, and alarm functions.

(i) For Undervoltage Relays (27):
  (a) Determine dropout voltage.
  (b) Determine time delay.
  (c) Determine the time delay at a second point on the timing curve for inverse time relays.

(j) For Instantaneous Overcurrent relay (50):
  (a) Determine pickup.
  (b) Determine dropout.
  (c) Determine time delay.

(k) For Time Overcurrent Relay (51):
  (a) Determine minimum pickup
  (b) Determine time delays at two points on the time current curve.

E25. MOTORS, INDUCTION, AC, 600 V

E25.1 Inspection and testing shall be comprised of the following:

(a) Note the equipment nameplate data for inclusion in the report.

(b) Inspect physical and mechanical condition.

(c) Inspect anchorage, alignment, and grounding.

(d) Inspect air baffles, filter media, cooling fans, slip rings, brushes, and brush rigging. Air baffles and filter media should be clean. Cooling fans should operate. Slip ring wear and brushes should be within manufacturer's tolerances for continued use. Brush rigging should be intact.

(e) Clean the unit.

(f) Inspect bolted electrical connections for high resistance using a low-resistance ohmmeter. Compare bolted connection resistance values to values of similar connections. Investigate values which deviate from those of similar bolted connections by more than 50 percent of the lowest value.

(g) Verify the application of appropriate lubrication and lubrication systems.

(h) Verify the absence of unusual mechanical or electrical noise or signs of overheating.

(i) Measure the ground resistance.

(j) Perform insulation-resistance tests in accordance with ANSI/IEEE Standard 43. Test voltage shall be in accordance with manufacturer's published data or 500 Vdc.
  (i) Where possible, test each winding separately. Ground all windings not under test.
  (ii) Ensure all cables and accessories are disconnected during the test.

(iii) For motors <= 150kW (200 HP), the test duration is to be one (1) minute. Calculate the dielectric absorption ratio.

(iv) For motors > 150kW (200 HP), the test duration is to be ten (10) minutes. Calculate the dielectric absorption ratio and polarization index.

(v) Correct test results to 40 °C.

(vi) Investigate readings below 100 megaohms.

(k) Where it is not possible to perform an insulation resistance test separately on each winding, perform a winding resistance test on each winding using a low-resistance ohmmeter.

(l) Perform insulation-resistance test on insulated bearings in accordance with manufacturer's published data, if applicable.

(m) Perform resistance tests on resistance temperature detector (RTD) circuits. RTD circuits should conform to design intent and/or machine protection device manufacturer's specifications.

E26. MOTOR STARTERS, 600 V

E26.1 Inspection and testing shall be comprised of the following:

(a) Note the equipment nameplate data for inclusion in the report.

(b) Record all adjustable settings, size of overload, etc.

(c) Inspect physical and mechanical condition.

(d) Inspect anchorage, alignment, and grounding.

(e) Clean the unit.

(f) Torque all accessible bolted power connections.

(g) Inspect contactors for evidence of overheating or stress.

(h) Visually inspect and exercise circuit breaker.

(i) If power fuses are present, record fuse size and type. Measure the resistance of each fuse. Investigate inconsistent resistance values.

E27. VARIABLE FREQUENCY DRIVE, 600V

E27.1 Inspection and testing shall be comprised of the following:

(a) Inspect physical and mechanical condition.

(b) Inspect anchorage, alignment, and grounding.

(c) Inspect for evidence of corrosion.

(d) Clean the unit.

(e) Check the air filters.

(f) Ensure vent path openings are free from debris and that heat transfer surfaces are not contaminated by oil, dust, or dirt.

(g) Verify correct connections of circuit boards, wiring, disconnects, and ribbon cables.

(h) Visually inspect VFD grounding to ensure continuity.

(i) Inspect condition of line reactors, if present.

(j) Inspect condition of DC Link Reactors, if present.

(k) Inspect condition of isolation transformers, if present.

(l) Inspect DC bus capacitors for bulging and leakage.

(m) Cooling fans and heat sinks:

(i) Visually inspect and listen for any abnormal noises or vibration.

(ii) Verify that fans rotate freely.

(iii) Verify correct direction of airflow.

(iv) Clean and verify integrity of heat sinks.

(n) Verify the operation of the grounding switch, if present.

E27.2 Record the following VFD Parameters:

(a) Motor voltage, current, frequency, nominal speed, nominal power,

(b) Control mode / method.

(c) Minimum and maximum control frequency.

(d) Acceleration and deceleration time.

(e) Compare drive overcurrent set points with motor full-load current rating to verify correct settings.

E27.3 Power fuses:

(a) Record fuse data. Confirm that the fuses are of the correct type and rating. Utilize manufacturer's published data where available.

(b) Measure fuse resistance.

E27.4 Bolted connections:

(a) Perform resistance measurements through bolted connections with a low-resistance ohmmeter. Compare bolted connection resistance values to values of similar connections. Investigate values which deviate from those of similar bolted connections by more than 50 percent of the lowest value.

(b) Torque all bolted connections.

E27.5 Inverter / Supply Module Power Connections:

(a) Remove each power module and visually inspect the contacts.

(b) Torque all cable connections.

(c) Clean all contact surfaces and apply suitable joint compound as recommended by manufacturer.

E27.6 Operator Interface:

(a) Check the display and keypad for proper operation and communication.

(b) Retrieve fault history log and note any faults.

E27.7 Grounding/Bonding measurements:

(a) Measure the resistance of the ground bonding connection between the VFD and the main grounding bus in the corresponding electrical room.

E27.8 Control Wiring:

(a) Check for tightness of all accessible control wiring and torque any loose connections.

E27.9 Perform operational tests by initiating control devices.

(a) Slowly vary drive speed between minimum and maximum. Observe motor and load for unusual noise or vibration.

(b) Verify operation of drive from local start/stop and speed control signals.

(c) Verify operation of all local pilot lights.

(d) Verify the operation of any emergency stop switches.

E27.10 Voltage and Current Testing:

(a) With the VFD under load, measure and record the following:
  (i) Measure and record incoming AC voltage and currents.
  (ii) Measure and record DC and AC bus voltages.
  (iii) Utilize a recording oscilloscope to capture the input voltage waveform and verify correct operation.
  (iv) Utilize a recording oscilloscope to capture the output voltage waveform and verify correct operation.
  (v) Include input and output waveforms with the report.

(b) With the VFD output in START/RUN mode, and at zero speed:
  (i) Measure and record the AC output voltage. Voltages above 40 VAC should be investigated.

E27.11 Affix an inspection sticker or inspection tag to each VFD in an appropriate place so that it will be conspicuous to all authorized personnel. This inspection notice must include, but is not limited to, equipment identifier, testing company name, date of inspection and the inspector's name. The sticker shall not obscure any equipment nameplates, readouts, or indicators.

E28. CAPACITORS, 600 V

E28.1 Inspection and testing shall be comprised of the following:

(a) Note the equipment nameplate data for inclusion in the report.

(b) Inspect physical and mechanical condition.

(c) Inspect anchorage, alignment, grounding, and required clearances.

(d) Clean the unit.

(e) Verify that capacitors are electrically connected in their specified configuration.

(f) Perform resistance measurements through bolted connections with a low-resistance ohmmeter. Compare bolted connection resistance values to values of similar connections. Investigate values which deviate from those of similar bolted connections by more than 50 percent of the lowest value.

(g) Perform insulation-resistance tests at 1000 Vdc for one minute from each phase terminal to the case. Note any resistance values less than 100 megaohms.

(h) Measure the capacitance of all terminal combinations. Investigate capacitance values differing from manufacturer's published data.

(i) Measure resistance of internal discharge resistors. Investigate discharge resistor values differing from manufacturer's published data. In accordance with Canadian Electrical Code 26-222, the residual voltage of a capacitor shall be reduced to 50 V within 1 minutes for capacitors rated less than 750 V.

E29. CIRCUIT BREAKERS, AIR, 600 V

E29.1 Inspection and testing shall be comprised of the following:

(a) Note the equipment nameplate data for inclusion in the report.

(b) Inspect physical and mechanical condition.

(c) Inspect anchorage, alignment and grounding.

(d) Verify that all maintenance devices are available for servicing and operating the breaker.

(e) Clean the unit.

(f) Torque all accessible bolted power connections.

(g) Inspect bolted electrical connections for high resistance using a low-resistance ohmmeter. Compare bolted connection resistance values to values of similar connections. Investigate

values which deviate from those of similar bolted connections by more than 50 percent of the lowest value.

(h) Inspect operating mechanism, contacts, and arc chutes for condition, wear and alignment.

(i) Verify that primary and secondary contact wipe and other dimensions vital to satisfactory operation of the breaker are correct.

(i) Measure and record the main and arcing contact gap.

(j) Perform mechanical operator and contact alignment tests on both the breaker and its operating mechanism.

(k) Verify cell fit and element alignment.

(l) Verify racking mechanism operation.

(m) Use appropriate lubrication on moving current-carrying parts and on moving and sliding surfaces.

(n) Record operation counter readings, if applicable.

(o) Perform insulation-resistance tests for one minute on each pole, phase-to-phase and phase-to-ground with the circuit breaker closed, and across each open pole. The minimum insulation-resistance should be 100 megaohms.

(a) 600 V poles shall be tested at 1000 Vdc.

(p) Perform a contact/pole-resistance test.

(q) Perform insulation-resistance tests on all control wiring with respect to ground. The applied potential shall be 500 Vdc for 300 V rated cable and 1000 Vdc for 600 V rated cable. Do not perform this test for units with solid-state components.

(r) Determine long-time pickup and delay by primary current injection. Long-time pickup values should be as specified, and the trip characteristic shall not exceed manufacturer's published time-current characteristic tolerance band, including adjustment factors. Circuit breakers exceeding specified trip time shall be identified as defective.

(s) Determine short-time pickup and delay by primary current injection. Short-time pickup values should be as specified, and the trip characteristic should not exceed manufacturer's published time-current tolerance band. Circuit breakers exceeding specified trip time shall be identified as defective.

(t) Determine ground-fault pickup and delay by primary current injection. Ground fault pickup values should be as specified, and the trip characteristic should not exceed manufacturer's published time-current tolerance band. Circuit breakers exceeding specified trip time shall be identified as defective.

(u) Determine instantaneous pickup current by primary current injection. Instantaneous pickup values should be within the tolerances of manufacturer's published data. Circuit breakers exceeding specified trip time shall be identified as defective.

(v) Secondary current injection may be utilized instead of primary current injection, provided that the current transformers are tested in accordance with E20.

(w) Perform minimum pickup voltage test on shunt trip and close coils. Minimum pickup voltage on shunt trip and close coils should be in accordance with manufacturer's published data.

(x) Verify correct operation of auxiliary features such as trip and pickup indicators, zone interlocking, and trip unit battery condition.

(y) Verify correct operation of features such as electrical close and trip operation, trip-free, and antipump function. Reset all trip logs and indicators.

E30. CIRCUIT BREAKERS, INSULATED-CASE/MOLDED CASE, 600 V

E30.1 Inspection and testing shall include the following:

(a) Note the equipment nameplate data for inclusion in the report.

(b) Record all adjustable settings.

(c) Inspect physical and mechanical condition.

(d) Inspect anchorage and alignment.

(e) Clean the unit.

(f) Torque all accessible bolted power connections.

(g) Operate the circuit breaker to insure smooth operation.

(i) Test all breakers utilizing the “Push-To-Trip” button, if equipped.

(ii) Move operating handle to the off and on position.

(iii) Restore breaker position to original position.

(h) For cables 4/0 AWG and larger, inspect bolted electrical connections for high resistance using a low-resistance ohmmeter. Compare bolted connection resistance values to values of similar connections. Investigate values which deviate from those of similar bolted connections by more than 50 percent of the lowest value.

E30.2 For breakers with a frame size greater or equal to 250A, or as specified elsewhere in the specification:

(a) Perform an insulation resistance test.

(i) Breakers rated < 600V, test voltage is to be 500 VDC.

(ii) Breakers rated >= 600V, test voltage is to be 1000 VDC.

(b) Perform a contact/pole-resistance test.

E31. EMERGENCY STANDBY GENERATORS, 600 V

E31.1 Diesel fuel storage tank(s) (NOT APPLICABLE AT SEWPCC FACILITY):

(a) Inspect day tank fuel level (gas pressure) and main tank level (gas pressure) (if applicable). Minimum 2 h supply required.

(b) The fuel oil in any storage tank (and day tank, if used) shall be tested in accordance with CSA C282, and if the fuel oil fails the test, it shall be

(i) drained and refilled with fresh fuel in accordance with the National Fire Code of Canada; or

(ii) full filtered to remove water, scale, bacteria, and oxidized gums/resins in order to minimize filter clogging and ensure diesel start-up.

(c) When the fuel is filtered, it shall be treated with a suitable conditioner and stabilizer to minimize degradation while in storage.

(d) The bottom(s) of the tank(s) shall be also tested chemically for water.

(e) Inspect for leakage.

(f) Inspect for proper operation of fuel transfer pump (if applicable).

E31.2 Engine:

(a) Inspect engine and cooling system for leakage.

(b) Inspect lubricating oil level.

(c) Inspect engine coolant level.

(d) Test lubricant and/or coolant heaters for proper operation.

(e) Inspect governor control linkages and oil level (if applicable).

(f) Inspect fuel pump oil sump (if applicable).

(g) Inspect fan belts for correct tension and wear.

(h) Inspect fuel filter for contamination if filter is equipped with a transparent bowl.

(i) Change engine lubrication oil and filters.

(j) Test strength of coolant and chemical protection level of coolant inhibitors.

(k) Change fuel filters, clean strainer(s), and verify that the fuel supply valve is open.

(l) Inspect the exhaust system. Check and record the back pressure of the exhaust system to ensure that it complies with the engine manufacturer's requirements, and compare with previous readings.

(m) Clean and lubricate linkages.

(n) Inspect air filters.

(o) Inspect all mechanical connections.

(p) Inspect all electrical connections.

(q) Inspect and clean engine crankcase breathers.

(r) Inspect and clean all engine linkages.

(s) Lubricate the engine governor and ventilation system.

(t) For spark ignition engines, inspect all components of ignition system(s) and service or replace as appropriate.

(u) Inspect all external surfaces of heat exchanger(s) and clean as necessary.

(v) Inspect all belts and hoses and replace if necessary.

(w) Test and inspect ignition system(s). Replace any defective components.

(x) Inspect coolant pump(s) for leaks and external wear (if belt driven, remove the belt(s) first).

(y) Drain and flush the cooling system. Refill the system with new coolant.

(z) Clean radiator tubes and cooling fins.

(aa) Replace thermostats.

(bb) Inspect valve clearances and adjust as appropriate.

(cc) Before start-up, perform two full cranking cycles (as specified in CSA C282). Near the end of each cycle (and while still cranking), measure and record the lowest indicated battery voltage. If the measured voltage is less than 80% of the battery's rated voltage, replace the battery. Alternatively, perform a battery load test using a suitable load tester.

(dd) Inspect ventilation system belt(s).

(ee) Inspect block heater hoses and wires.

(ff) Electric starter system:

- (i) Inspect electric starter for cleanliness, mounting, and terminal security.

(gg) Air starter (If applicable):

- (i) Inspect air tanks for pressure.
- (ii) Inspect valves for leakage.
- (iii) Test auxiliary engine and compressor for proper operation.
- (iv) Bleed off any condensation.

(hh) Batteries and charging equipment:

- (i) Inspect all battery cells for correct electrolyte fill level.
- (ii) Test all battery cells for correct electrolyte specific gravity.
- (iii) Inspect electrical connections for tightness and evidence of corrosion.
- (iv) Inspect battery for cleanliness and dryness between terminals.
- (v) Inspect charger electrical connections for cleanliness and tightness.
- (vi) Test charger for proper operation of float and equalize modes.

E31.3 Generator:

(a) Test protective devices for proper operation.

(b) Test surge suppressor and rotating rectifier on brushless machines.

(c) Grease bearings (replace old grease with new) (if applicable).

(d) Clean commutator and slip rings (if applicable).

(e) Clean rotor and stator windings using clean compressed air.

(f) Inspect coupling bolts and alignment.

(g) Inspect conduits for tightness.

(h) Inspect windings at rotor and stator slots.

(i) Inspect all electrical connections.

(j) With the generator set operating at full load, conduct an infrared survey of all electrical connections to identify any high-resistance connections.

(k) Perform insulation-resistance tests on the windings. Test voltage shall be in accordance with manufacturer's published data or 500 Vdc.

(i) Where possible, test each winding separately. Ground all windings not under test.

(ii) Ensure all cables and accessories are disconnected during the test.

(iii) For generators <= 150kW, the test duration is to be one (1) minute. Calculate the dielectric absorption ratio.

(iv) For generators > 150kW, the test duration is to be ten (10) minutes. Calculate the dielectric absorption ratio and polarization index.

(v) Correct test results to 40 °C.

(vi) Investigate readings below 100 megaohms. Immediately identify any readings (in megaohms) less than (Rated Voltage + 1000) / 1000.

(l) If the resistance is less, dry out the insulation using the auxiliary heat process.

E31.4 Generator Main Breaker:

(a) Perform field inspection and check for any loose connections, missing components.

(b) Perform resistance measurements through bolted connections.

(c) Perform insulation resistance tests on the panel.

(d) Clean the enclosure.

(e) Inspect insulators for evidence of any damage.

(f) Exercise all active components

(g) Inspect all mechanical indicators for correct operation.

(h) Verify that filters/ vents are clean.

(i) Inspect and test protective relays as specified in E24

(j) Inspect and test air circuit breakers as specified in E29.

(k) Inspect and test moulded case circuit breakers as specified in E30.

E31.5 Control panel:

(a) Inspect control panel covers for security.

(b) Test annunciator lamps to confirm that they are operational.

(c) Inspect control panel settings (ensure that the unit is ready for automatic start-up).

(d) Test remote visual and audible trouble signals at the building fire alarm panel.

(e) Open all inspection covers and inspect all electrical connections.

(f) Test breakers for proper operation.

(g) Clean insulators and bushings.

(h) Test voltage regulator for proper operation.

(i) Operate all moving parts to ensure that they move freely.

(j) Clean and dress contacts as necessary.

(k) Remove all dust.

(l) Check gauge calibration.

(m) With the generator set operating at full load, conduct an infrared survey of all electrical connections to identify any high-resistance connections.

E31.6 Generator Room:

(a) Inspect air control louvre settings to ensure proper operation.

(b) Test emergency lighting unit(s), if present.

(c) Verify whether room temperature is above 10 °C.

(d) Inspect generator and transfer switch room(s) for cleanliness and accessibility to all components of the emergency system.

E31.7 Test and verify the entire system as follows:

(a) Simulate a failure of the normal electrical supply to the building and verify correct operation.

(b) Perform a two hour load test, together with the transfer switch.

(i) For generators <= 500 kW, this is to be a full-load test as per C282.

(ii) For generators > 500 kW, this is permitted to be a load test utilizing the maximum load possible from operation of plant equipment.

(c) Operate all automatic transfer switches under load.

(d) Inspect brush operation for sparking.

(e) Inspect for bearing seal leakage.

(f) Inspect for correct operation of all auxiliary equipment, e.g., radiator shutter control, coolant pumps, fuel transfer pumps, oil coolers, and engine room ventilation system(s).

(g) Record the readings for all instruments and verify that they are normal.

(h) Drain the exhaust system condensate trap.

E31.8 Inspection forms are to be provided by the Contractor for this portion of the inspection.

E31.9 Affix an inspection sticker or inspection tag in an appropriate place so that it will be conspicuous to all authorized personnel. This inspection notice must include, but is not limited to, testing company name, date of inspection and the inspector's name. The sticker shall not obscure any equipment nameplates, readouts, or indicators.

E32. TRANSFER SWITCHES, 600 V

Inspection and testing shall be comprised of the following:

(a) Isolate transfer switch, open all inspection covers, and inspect all electrical connections.

(b) Operate all moving parts to ensure that they move freely.

(c) Clean and dress contacts as required.

(d) Remove all dust.

(e) Clean and lubricate linkages.

(f) Conduct an infrared survey of all electrical connections, contacts, and energized components while under load on both the normal and the emergency side.

(g) Lubricate door locks and hinges (if necessary), especially those of outdoor enclosures.

(h) Conduct a 2 hour load test.

(i) For generators <= 500 kW, this is to be a full-load test as per C282.

(ii) For generators > 500 kW, this is permitted to be a load test utilizing the maximum load possible from operation of plant equipment.

(i) Perform resistance measurements through bolted connections.

(j) Perform an insulation resistance test on the transfer switch in each position.

(i) Rated < 600V, test voltage is to be 500 VDC.

(ii) Rated >= 600V, test voltage is to be 1000 VDC.

(k) Inspection forms are to be provided by the Contractor for this portion of the inspection.

(l) Affix an inspection sticker or inspection tag in an appropriate place so that it will be conspicuous to all authorized personnel. This inspection notice must include, but is not limited to, testing company name, date of inspection and the inspector's name. The sticker shall not obscure any equipment nameplates, readouts, or indicators.

E33. TRANSFORMERS, LOW VOLTAGE, DRY-TYPE

Inspection and testing shall be comprised of the following:

(a) Note the equipment nameplate data for inclusion in the report.

(b) Inspect physical and mechanical condition.

(c) Inspect anchorage, alignment, and grounding.

(d) Clean the unit.

(e) Torque all accessible bolted power connections.

(f) Record the tap setting.

(g) Perform insulation-resistance tests winding-to-winding and each winding-to-ground. Duration of the test is to be one minute. Calculate the dielectric absorption ratio.

(a) 600 V windings shall be tested at 1000 Vdc.

(b) 120/208 V windings shall be tested at 500 Vdc.

E34. TRANSFORMERS, LOW VOLTAGE, LIQUID-FILLED

Inspection and testing shall be comprised of the following:

(a) Note the equipment nameplate data for inclusion in the report.

(b) Inspect physical and mechanical condition.

(c) Inspect anchorage, alignment, and grounding.

(d) Verify the presence of PCB labelling, if applicable.

(e) Clean bushings and control cabinets.

(f) Verify operation of alarm, control, and trip circuits from temperature and level indicators, pressure relief device, and fault pressure relay, if applicable. Alarm, control, and trip circuits from temperature and level indicators as well as pressure relief device and fault pressure relay should operate within manufacturer's recommendations for their specified settings.

(g) Inspect bolted electrical connections for high resistance using a low-resistance ohmmeter. Compare bolted connection resistance values to values of similar connections. Investigate values which deviate from those of similar bolted connections by more than 50 percent of the lowest value.

(h) Verify correct liquid level in tanks and bushings. Liquid levels in the transformer tanks and bushings should be within indicated tolerances.

(i) Record tap setting. Confirm the tap setting appears reasonable by measuring the voltage during normal facility operation.

(j) Perform insulation-resistance tests winding-to-winding and each winding-to-ground. The duration of the test is to be ten (10) minutes. Correct the reading to a temperature of 20°C. Calculate polarization index. Minimum insulation-resistance values of transformer insulation should be 100 megaohms. Values of insulation resistance less than the values stated should be investigated. The polarization index should not be less than 1.0.

(a) 600 V windings shall be tested at 1000 Vdc.

(b) 480 V windings shall be tested at 1000 Vdc.

(c) 280 V windings shall be tested at 500 Vdc.

(k) Measure the resistance of each winding at the designated tap position. Calculate and record temperature corrected winding-resistance values for a temperature of 85°C.

(l) If the core ground strap is accessible, remove and measure the core insulation resistance at 500 Vdc. Correct the reading to a temperature of 20°C.

(m) Remove a sample of insulating liquid in accordance with ASTM D 923. The sample shall be tested for the following.

(a) Dielectric breakdown voltage: ASTM D 877 and/or ASTM D 1816

(b) Acid neutralization number: ANSI/ASTM D 974

(c) Specific gravity: ANSI/ASTM D 1298

(d) Interfacial tension: ANSI/ASTM D 971 or ANSI/ASTM D 2285

(e) Color: ANSI/ASTM D 1500

(f) Visual Condition: ASTM D 1524

(g) Measure power factor or dissipation factor in accordance with ASTM D 924.

(n) Remove a sample of insulating liquid in accordance with ASTM D 3613 and perform dissolved-gas analysis (DGA) in accordance with ANSI/IEEE C57.104 or ASTM D3612. Evaluate results of dissolved-gas analysis in accordance with ANSI/IEEE Standard C57.104.

E35. PANELBOARDS, LOW VOLTAGE

Inspection and testing shall be comprised of the following:

(a) Note the equipment nameplate data for inclusion in the report.

(b) Inspect physical and mechanical condition.

(c) Inspect anchorage, alignment, and grounding.

(d) Clean the unit.

(e) Inspect breakers and verify mechanical operation by exercising all circuit breakers.

(i) Record breaker data on the inspection form.

(ii) Test all breakers utilizing the “Push-To-Trip” button, if equipped.

(iii) Move operating handle to the off and on position.

(iv) Restore breaker position to original position.

(f) Test main and feeder/load breakers with a frame size >= 250A, or with long, short, or ground fault settings in accordance with E30, and complete a separate inspection form for each.

(g) Torque all accessible bolted power connections including incoming, load neutral and ground connections.

(h) Perform insulation-resistance tests on each bus phase with all other phases grounded.

(a) The main breaker, if present, is to be open for the test. If no main breaker is present, disconnect the supply conductors.

(b) Open all load breakers.

(c) Test voltage for all 600/347 V panelboards to be 1000 Vdc.

(d) Test voltage for all 120/208 V panelboards to be 500 Vdc.

E36. GROUNDING SYSTEM

Inspection and testing shall be comprised of the following:

(a) Perform resistance tests between the main grounding electrode and grounded points in the electrical distribution system located in the switchgear, transformers, and MCCs. Investigate connections with a resistance greater than 0.5 milliohms.

E37. THERMOGRAPHIC TESTS

Inspection and testing shall be comprised of the following:

(a) Remove all necessary covers prior to thermographic inspection.

(b) Equipment to be inspected shall include all current-carrying devices.

(c) Camera Requirements:
  (i) Minimum resolution: 320 x 240.
  (ii) Accuracy: +/-2°C or +/-2% of reading at 30 °C

(d) Test Parameters
  (a) Inspect distribution systems with imaging equipment capable of detecting a minimum temperature difference of 2 °C at 30 °C.
  (b) Equipment shall detect emitted radiation and convert detected radiation to a visual signal.
  (c) Thermographic surveys should be performed during periods of maximum possible loading but not less than 40% of rated load of the electrical equipment being inspected. Coordinate with City as required.
  (d) Note and investigate all significant temperature differences.

(e) Re-inspect deficient areas with the thermographic camera following repairs and corrections, for deficient areas identified.

(f) Provide a report which shall include the following:
  (a) Description of the equipment tested.
  (b) Discrepancies found.
  (c) Temperature difference between the area of concern and the reference area.
  (d) Probable cause of temperature difference.
  (e) Identify any repairs made during the thermographic inspection. If no repairs were made, provide recommended action for repair.
  (f) Areas inspected. Identify inaccessible and / or unobservable areas and / or equipment.
  (g) Identify load conditions at time of inspection.
  (h) Provide photographs and thermograms of all areas investigated, with deficient areas identified.
  (i) Provide thermograms of all deficient areas corrected, and identify the load conditions at the time of re-inspection.

E38. HARMONICS MEASURMENTS

Testing shall be comprised of the following:

(a) Connect to existing CTs and PTs.

(b) Test duration at each location is to be 24 hours.

(c) Coordinate with operations personnel to ensure the loads run during the test are representative of normal plant operation.

(d) Monitor the following for all three phases:
  (i) Voltage, current, and power factor
  (ii) Harmonic voltage level for 1^{st} (base) through 15^{th} harmonics.

(iii) Harmonic current level for 1st (base) through 15th harmonics, expressed in % of current.

(iv) Total harmonic distortion (THD)

(e) Record samples as two (2) minute intervals.

(f) Provide Microsoft Excel files of the test results.

(g) Provide a summary page in the report indicating the THD, and maximum, average, and minimum for each voltage and current harmonic.

CONSTRUCTION SPECIFICATIONS

E39. GENERAL

E39.1 Supply and install wire markers on all control wiring.

(a) Wire markers shall be white background heat-shrink type or equivalent and marked with an indelible black ink. Wire markers to be neat and legible.

E39.2 All new installed component nameplates shall be lamacoids with white face and black lettering. Install utilizing self-tapping screws.

E39.3 Submittals

(a) Submit product datasheets of all products to be utilized prior to procurement.

(b) Submit shop drawings for all panels manufactured.

E39.4 Terminal block requirements:

(a) Utilize clamp on terminal blocks compatible with 35mm steel DIN rail.

(b) CSA approved.

(c) 600V, 20A rated.

(d) Label using manufacturer approved push-on printed terminal markers. Labels to be based on the drawings.

E39.5 Wires and cables

(a) Internal switchgear wiring shall be CSA, rated 90C, 600V SIS switchboard wire, size 14 AWG, stranded bare copper conductor, XLPE type VW1 insulated.

(b) Internal MCC/VFD wiring shall be CSA, TEW, 14 AWG, stranded copper conductor.

(c) Wiring in conduits to be CSA RW90, 14 AWG, stranded copper conductor, XLPE insulated.

E39.6 Conduits

(a) All conduits to be rigid aluminum, minimum 20mm diameter.

(b) Ensure appropriate bonding of all conduits.

(c) Conduit routing must be approved by the Contract Administrator. Relocate conduit to the satisfaction of the Contractor Administrator as required.

E39.7 The Contractor is responsible for supply, delivery, installation, testing, and commissioning of all required work.

E39.8 Coordination and scheduling will be required to obtain access to the required switchgear. Allow for sufficient time in the schedule to coordinate required shutdowns with the City.

E39.9 Operations and Maintenance Manual Requirements:

(a) Submit two (2) advance copies of the manual prior to Substantial Performance of the Work for review and comments.

(b) Revise content of documents as required prior to final submittal.

(c) After review, four (4) copies of the final manuals shall be submitted. Each copy shall be clearly titled to show all of the information required by the Specifications as well as operational information including:

(i) the item of Work concerned

(ii) City's Contract number, the name and address of the Contractor, the issue date, operational information on equipment, overhaul and adjustment schedules.

(d) Furnish evidence, if requested, for type, source and quality of products provided.

E39.9.1 In addition to information called for in the Specifications, include the following:

(a) Title sheet, labelled "Operation and Maintenance Instructions", and containing project name and date.

(b) List of contents.

(c) Brochures/catalogue excerpts of all components of the Work.

(d) Documentation of all test results.

(e) Installation, start-up, O&M Manuals

(f) Reviewed Shop Drawings of all equipment.

(g) Names, addresses, and telephone numbers of all major sub-contractors and suppliers.

(h) The Contractor shall modify and supplement the manual as required by the Contract Administrator.

E39.9.2 Format to be as follows:

(a) Organize data as instructional manual.

(b) Binders: vinyl, hard covered, 3 'D' ring, with spine and face pockets.

(c) When multiple binders are used correlate data into related consistent groupings.

(d) Identify contents of each binder on spine.

(e) Drawings: provide with reinforced punched binder tab. Bind in with text; fold larger drawings to size of text pages.

E40. SGR-S1 & SGR-S2 MODIFICATIONS

E40.1 Submit product data sheets review prior to purchase of components. Where datasheetshave multiple model numbers, clearly indicate the selected model number. Datasheets are to be provided for:

(a) Potential Transformers.

(b) Voltmeters.

(c) Voltmeter Switches.

E40.2 The internal wiring shall be CSA, rated 90C, 600V SIS switchboard wire, size 14 AWG, stranded bare copper conductor, XLPE type VW1 insulated.

E40.3 Voltmeter requirements:

(a) CSA approved analog RMS indicating type AC Switchboard Voltmeter (4-1/4" square, rotary (250°) 0-750V scale with left positioned zero, 150V AC 60Hz rated), to be mounted flush on front door, as shown on the drawing. During normal operation the Voltmeter shall be fed 120V AC from the new voltage transformer (600V/120V) specified and the Voltmeter must read 600V at 120V AC input (on a scale of 750V). The accuracy shall be 1%. The voltmeter shall be in a sealed metal cover and metal case, with shielded mechanism, linear moving coil movement and designed for shock and vibration resistance. The scale shall be easy to read. The voltmeter shall be suitable for an ambient of 0°C to 40°C. The voltmeter shall have an overload rating of 120% (continuous) and a dielectric withstand of 2300V AC for 1 minute.

E40.4 Potential Transformer requirements:

(a) CSA approved/ C-UL listed 3-phase voltage transformer units, rated 600V/120V in an open–delta configuration, 600V AC input (phase-phase), 120V AC output (phase-phase) with terminals marked as 1H1-1H2 for Primary winding 1, 2H1-2H2 for Primary winding 2, 1X1-1X2 for secondary winding 1, 2X1-2X2 for secondary winding 2. The Insulation level shall be >600V AC, 10KV BIL. Accuracy shall be 1% at all burdens at 0.95PF. Standard of acceptance is *GE Multilin 2VT469-600*.

E40.5 Voltmeter Switch requirements:

(a) CSA approved Voltage selector switches (Voltmeter transfer switches) in three phase, phase to phase indicating selection (1-2, 2-3, 3-1, OFF), rated 30A, 600V, AC, 60Hz, in low resistance double wiping self cleaning contacts, equipped with round knurled front handle, and for front panel door mounting on LV compartments. Standard of acceptance is *Series-24 Electroswitch*.

E40.6

(a) CSA approved fuses for primary and secondary circuits as recommended by the voltage transformer manufacturer. Suggested size is 0.25A 600V primary (6 no.) and 0.4A 600V secondary (4 no.)

E40.7 Provide Department of Labour approval of all switchgear modifications. Furnish certificates with O&M manuals.

E40.8 DCP-S10 pushbutton station requirements:

(a) CSA approved/ C-UL listed NEMA-12 wall mounted enclosure (10”Hx 8”Wx 6”D) as shown on drawing, and mounted near the entrance door.

(b) CSA approved/ C-UL listed NEMA-4X push buttons with 6A, 600V AC, 1NO contact block, with green operator for OPEN and red operator for CLOSE push button. Provide all push buttons with *protective guards* for preventing inadvertent operation.

(c) Screwed on lamacoid nameplate.

(d) The DCP-S10 internal pushbutton station wiring shall be CSA, 600V TEW, 14 AWG, stranded bare copper conductor.

(e) Panel to be supplied by a CSA approved panel shop and CSA approved.