



**THE CITY OF WINNIPEG**

# **BID OPPORTUNITY**

**BID OPPORTUNITY NO. 682-2005**

**WINNIPEG WATER TREATMENT PROGRAM – SUPPLY OF STANDBY  
GENERATORS AND 5 KV SWITCHGEAR**

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## **PART B - BIDDING PROCEDURES**

### **B1. PROJECT TITLE**

- B1.1 WINNIPEG WATER TREATMENT PROGRAM – SUPPLY OF STANDBY GENERATORS AND 5 KV SWITCHGEAR

### **B2. SUBMISSION DEADLINE**

- B2.1 The Submission Deadline is 4:00 p.m. Winnipeg time, January 18, 2006.
- B2.2 Bid Submissions 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. ENQUIRIES**

- B3.1 All enquiries shall be directed to the Contract Administrator identified in D4.1.
- B3.2 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.
- B3.3 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.
- B3.4 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.
- B3.5 The Bidder shall not be entitled to rely on any response or interpretation received pursuant to B2.3 unless that response or interpretation is provided by the Contract Administrator in writing.

### **B4. ADDENDA**

- B4.1 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.
- B4.2 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.
- B4.2.1 Addenda will be available on the Bid Opportunities page at The City of Winnipeg, Corporate Finance, Materials Management Branch internet site at <http://www.winnipeg.ca/matmgt>.
- B4.2.2 The Bidder is responsible for ensuring that he has received all addenda and is advised to check the Materials Management Branch internet site for addenda shortly before submitting his Bid.
- B4.3 The Bidder shall acknowledge receipt of each addendum in Paragraph 10 of Form A: Bid. Failure to acknowledge receipt of an addendum may render a Bid non-responsive.

## **B5. SUBSTITUTES**

- B5.1 The Work is based on the materials, equipment, methods and products specified in the Bid Opportunity.
- B5.2 Substitutions shall not be allowed unless application has been made to and prior approval has been granted by the Contract Administrator in writing.
- B5.3 Requests for approval of a substitute will not be considered unless received in writing by the Contract Administrator at least seven (7) Business Days prior to the Submission Deadline.
- B5.4 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 material, equipment, method or product 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 Contract;
  - (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 Contract.
- B5.5 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.
- B5.6 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.
- B5.6.1 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.
- B5.7 If the Contract Administrator approves a substitute as an “approved equal”, any Bidder may use the approved equal in place of the specified item.
- B5.8 If the Contract Administrator approves a substitute as an “approved alternative”, any Bidder bidding that approved alternative shall 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.
- B5.9 No later claim by the Contractor for an addition to the price(s) because of any other changes in the Work necessitated by the use of an approved equal or an approved alternative will be considered.

## **B6. BID SUBMISSION**

- B6.1 The Bid Submission consists of the following components:

- (a) Form A: Bid;
- (b) Form B: Prices;
- (c) Form G1: Bid Bond and Agreement to Bond, or  
Form G2: Irrevocable Standby Letter of Credit and Undertaking, or  
a certified cheque or draft;

B6.2 All components of the Bid Submission 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 in ink, to constitute a responsive Bid.

B6.3 The Bid Submission shall be submitted enclosed and sealed in an envelope clearly marked with the Bid Opportunity number and the Bidder's name and address.

B6.3.1 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.

B6.4 Bid Submissions submitted by facsimile transmission (fax) or internet electronic mail (e-mail) will not be accepted.

B6.5 Bid Submissions shall be submitted to:

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

## **B7. BID**

B7.1 The Bidder shall complete Form A: Bid, making all required entries.

B7.2 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.

B7.2.1 If a Bid is submitted jointly by two or more persons, each and all such persons shall identify themselves in accordance with B7.2.

B7.3 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.

B7.4 Paragraph 12 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 and the corporate seal, if the corporation has one, should be affixed;
- (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.

B7.4.1 The name and official capacity of all individuals signing Form A: Bid shall be printed below such signatures.

B7.4.2 All signatures shall be original and shall be witnessed except where a corporate seal has been affixed.

B7.5 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 Submission and the Contract, when awarded, shall be both joint and several.

## **B8. PRICES**

B8.1 The Bidder shall state the lump sum price in Canadian funds for the Work on Form B: Prices.

B8.1.1 The price on Form B: Prices shall include:

- (a) duty;
- (b) freight and cartage;
- (c) Provincial and Federal taxes [except the Goods and Services Tax (GST) and Manitoba Retail Sales Tax (MRST, also known as PST), which shall be extra where applicable] and all charges governmental or otherwise paid;
- (d) profit and all compensation which shall be due to the Contractor for the Work and all risks and contingencies connected therewith.

B8.2 Payment of the lump sum price will be made to the Contractor in accordance with the payment schedule set out in D19.

## **B9. QUALIFICATION**

B9.1 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, or if the Bidder does not carry on business in Manitoba, in the jurisdiction where the Bidder does carry on business;
- (b) be responsible and not be suspended, debarred or in default of any obligation to the City;
- (c) be financially capable of carrying out the terms of the Contract;
- (d) have all the necessary experience, capital, organization, and equipment to perform the Work in strict accordance with the terms and provisions of the Contract;
- (e) have successfully carried out work, similar in nature, scope and value to the Work;
- (f) employ only Subcontractors who:
  - (i) are responsible and not suspended, debarred or in default of any obligation 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 Branch internet site at <http://www.winnipeg.ca/matmgt>); and
  - (ii) have successfully carried out work similar in nature, scope and value to the portion of the Work proposed to be subcontracted to them, and are fully capable of

performing the Work required to be done in accordance with the terms of the Contract;

- (g) have a written workplace safety and health program in accordance with The Workplace Safety and Health Act (Manitoba);

B9.2 The Bidder shall be prepared to 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.

B9.3 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.

## **B10. BID SECURITY**

B10.1 The Bidder shall provide bid security in the form of:

- (a) a bid bond, in the amount of at least ten percent (10%) of the Total Bid Price, and agreement to bond of a company registered to conduct the business of a surety in Manitoba, in the form included in the Bid Submission (Form G1: Bid Bond and Agreement to Bond); or
- (b) an irrevocable standby letter of credit, in the amount of at least ten percent (10%) of the Total Bid Price, and undertaking 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 included in the Bid Submission (Form G2: Irrevocable Standby Letter of Credit and Undertaking); or
- (c) a certified cheque or draft payable to "The City of Winnipeg", in the amount of at least fifty percent (50%) of the Total Bid Price, drawn on a bank or other financial institution registered to conduct business in Manitoba.

B10.1.1 If the Bidder submits alternative bids, the bid security shall be in the amount of the specified percentage of the highest Total Bid Price submitted.

B10.2 The bid security of the successful Bidder and the next two lowest evaluated responsive and responsible Bidders will be released by the City when a Contract for the Work has been duly executed by the successful Bidder and the performance security furnished as provided herein. The bid securities of all other Bidders will be released when a Contract is awarded.

B10.2.1 Where the bid security provided by the successful Bidder is in the form of a certified cheque or draft pursuant to B10.1(c), it will be deposited and retained by the City as the performance security and no further submission is required.

B10.2.2 The City will not pay any interest on certified cheques or drafts furnished as bid security or subsequently retained as performance security.

B10.3 The bid securities of all Bidders will be released by the City as soon as practicable following notification by the Contract Administrator to the Bidders that no award of Contract will be made pursuant to the Bid Opportunity.

## **B11. OPENING OF BIDS AND RELEASE OF INFORMATION**

B11.1 Bid Submissions will not be opened publicly.

B11.2 Within two (2) Business Days 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 Branch internet site at <http://www.winnipeg.ca/matmgt>.

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 Branch internet site at <http://www.winnipeg.ca/matmgt>.

B11.4 The Bidder is advised that any information contained in any Bid Submission 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 11 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 11 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 GC.7.05(2), 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 12 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 shall:

- (a) retain the Bid Submission until after the Submission Deadline has elapsed;
- (b) open the Bid Submission to identify the contact person named in Paragraph 3 of Form A: Bid and the Bidder's authorized representatives named in Paragraph 12 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, including the right to retain the Bidder's bid security.

## **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 (pass/fail);
- (b) qualifications of the Bidder and the Subcontractors, if any, pursuant to B9 (pass/fail);

- (c) Total Bid Price;
- (d) economic analysis of any approved alternative pursuant to B5.

B14.2 Further to B14.1(a), the Award Authority may reject a Bid as being non-responsive if the Bid Submission 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 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 Submission 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 lump sum price shown on Form B: Prices.

B14.4.1 If there is any discrepancy between the lump sum price written in figures and the lump sum price written in words, the price written in words shall take precedence.

B14.5 This Contract will be awarded as a whole.

## **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.

## **PART C - GENERAL CONDITIONS**

### **C1. GENERAL CONDITIONS**

C1.1 The *General Conditions for the Supply and Delivery of Goods* (Form 21: 88 03) are applicable to the Work of the Contract.

C1.1.1 The *General Conditions for the Supply and Delivery of Goods* are available on the Information Connection page at The City of Winnipeg, Corporate Finance, Materials Management Branch internet site at <http://www.winnipeg.ca/matmgt>.

## **PART D - SUPPLEMENTAL CONDITIONS**

### **GENERAL**

#### **D1. GENERAL CONDITIONS**

- D1.1 In addition to the *General Conditions for the Supply and Delivery of Goods*, these Supplemental Conditions are applicable to the Work of the Contract.
- D1.2 The General Conditions are amended by striking out "The City of Winnipeg Act" wherever it appears in the General Conditions and substituting "The City of Winnipeg Charter".
- D1.3 The General Conditions are amended by striking out "Board of Commissioners" or "Commissioner" wherever it appears in the General Conditions and substituting the "Chief Administrative Officer".
- D1.4 The General Conditions are amended by striking out "Tender Package" wherever it appears in the General Conditions and substituting "Bid Opportunity".
- D1.5 The General Conditions are amended by striking out "Tender Submission" wherever it appears in the General Conditions and substituting "Bid Submission".
- D1.6 The General Conditions are amended by striking out "Bidding Instructions" wherever it appears in the General Conditions and substituting "Bidding Procedures".

#### **D2. SCOPE OF WORK**

- D2.1 The Work to be done under the Contract shall consist of the supply of standby generators and 5 kV switchgear.
- D2.2 The major components of the Work are as follows:
- (a) To supply two (2) or three (3) equally sized standby generators, 4160V, with a combined capacity of 6.0 MW;
  - (b) To supply three (3) outdoor diesel fuel storage tanks;
  - (c) To supply diesel fuel pumps, strainers, filters and pressure regulators;
  - (d) 5 kV primary switchgear and 5 kV generator switchgear;
  - (e) For all equipment supplied under this Contract provide: delivery to Site, training, performance verification support, operation and maintenance manuals, equipment, accessories and spare parts;
  - (f) Electrical scope as specified in Section 16015, including complete short circuit study, coordination study and grounding system analysis; and,
  - (g) Control and instrumentation scope as specified in Section 17010.
- D2.3 The Site is located on Provincial Road 207, 3 km north of Highway 1 in Dugald, Manitoba.
- D2.3.1 The Site address is PR207, Lot 57082, Dugald, Manitoba.
- D2.3.2 Provincial Road 207 is a class B1 road and is subject to seasonal load restrictions which will affect the maximum weight of individual deliveries. However, The City of Winnipeg and Manitoba Transportation and Government Services (TGS) have reached an agreement to facilitate construction of the Winnipeg Water Treatment Program as follows:
- (a) The approximately 3.2 km of PR 207 between the entrance to the Site and Highway 1 will be designated as an RTAC Route for construction of the Winnipeg Water

Treatment Program effective January 1, 2006 until TGS imposes Spring Restrictions. RTAC loadings will also be allowed after removal of the Spring Restriction.

- (b) During the TGS imposed spring weight restriction period, normal (non spring weight restriction) Class B1 Highway loadings will be allowed on the portion of PR 207 described in D2.3.2(a). The spring weight restriction period is normally in place from March 18 to May 26, but it is subject to change due to weather conditions as assessed by TGS.
- (c) The portion of PR 207 described in D2.3.2 (a) will be upgraded during 2006 to a RTAC Route. PR 207 will remain open during the upgrading process but will be subjected to intermittent delays due to road construction.
- (d) TGS issued permits will be required for each construction vehicle in excess of Class BI Highway loading from January 1, 2006 until the upgrade of PR 207 has been completed. The permit program for performance of the Work will be as follows:
  - (i) The permit shall be obtained by the registered owner of the vehicle(s);
  - (ii) The registered vehicle owner shall apply to the Permit Services unit of TGS by phone (945-3961). The applicant will be given a permit number at the time of application, thereby allowing immediate travel;
  - (iii) The permit fee will be \$20 and will be good for 1 year. The \$20 fee is a fleet fee;
  - (iv) The permit will be mailed to the applicant and a copy is to be carried in each vehicle;
  - (v) TGS will be making spot compliance checks; and
  - (vi) The Contractor shall be responsible for the costs incurred in applying for and managing the permit program as required for the performance of the Work.

### D3. DEFINITIONS

D3.1 When used in this Bid Opportunity:

- (a) **"Business Day"** means any Calendar Day, other than a Saturday, Sunday, or a Statutory or Civic Holiday;
- (b) **"Submission Deadline"** and **"Time and Date Set for the Final Receipt of Bids"** mean the time and date set out in the Bidding Procedures for final receipt of Bids;
- (c) **Installation Contractor and/or Installer** means the General Contractor retained by the City, under a separate contract, to install the equipment supplied under this contract;
- (d) **Substantial Performance** shall have the meaning attributed to it in the Builders' Lien Act (Manitoba), or any successor legislation thereto.
- (e) **ANSI** means **American National Standards Institute**
- (f) **ASME** means **American Society of Mechanical Engineers**
- (g) **ASTM** means **American Society for Testing and Materials**
- (h) **AWWA** means **American Water Works Association**
- (i) **CSA** means **Canadian Standards Association**
- (j) **DAF** means **Dissolved Air Flotation**
- (k) **IEC** means **International Electrotechnical Commission**
- (l) **ISO** means **International Organization for Standardization**
- (m) **NACE** means **National Association of Corrosion Engineers**
- (n) **NEMA** means **National Electrical Manufacturers Association**
- (o) **NSF** means **National Sanitation Foundation**

- (p) **SAE** means **Society** of Automotive Engineers
- (q) **Manufacturer** means the person, partnership or corporation responsible for the manufacture and fabrication of equipment provided to the City for the completion of the work.
- (r) **Manufacturer's Representative** means a trained serviceman empowered by the manufacturer to provide installation, testing, and commissioning assistance to the City in his performance of those functions.
- (s) **IEEE** means Institute of Electrical and Electronics Engineers
- (t) **NEMA** means National Electrical Manufacturer's Association
- (u) **Furnish** means supply
- (v) **ISA** means the Instrumentation Systems and Automation Society
- (w) **Total Performance** means that the entire Work, except those items arising from the Provision of GC.10.01 have been performed in accordance with this Contract
- (x) **AGMA** means American Gear Manufacturer's Association.
- (y) **API** means American Petroleum Institute
- (z) **EEMAC** means Electrical and Electronic Manufacturer of Canada
- (aa) **VFD** means Variable Frequency Drive
- (bb) **VSD** means variable speed drive
- (cc) **Contract Work Schedule** means a Gantt Charter developed by the Contractor developed using the critical path method which shows the proposed progress of the major items of work which are to be performed under this Contract
- (dd) **Project Master Schedule** means a schedule developed by the Contract Administrator which includes and coordinates the Contract Work Schedules of several City contracts, including this Contract
- (ee) **Professional Engineer** means a professional engineer registered in the Province of Manitoba.
- (ff) **Major Equipment** means all equipment for which shop drawing submittals are required as specified in Division 11, 16 and 17.
- (gg) **Performance Verification** means all factory and field tests, demonstrations and other activities required from the Contractor to complete Form 103 – Certificate of Satisfactory Performance and to demonstrate to the Contract Administrator's satisfaction that the equipment supplied under this Contract is performing as specified herein.
- (hh) **Certified Shop Drawings** means Shop Drawings prepared by the Contractor after all required Shop Drawings have been "reviewed" or "reviewed as modified" in accordance with Section 01300 of this Bid Opportunity and which incorporate all modifications to the Shop Drawings, comments and notations made by the Contract Administrator in the course of the review.
- (ii) **Acceptable Shop Drawings** means all required Shop Drawings have been reviewed by the Contract Administrator and have been annotated and stamped as "reviewed" or "reviewed as modified" in accordance with Section 01300 of this Bid Opportunity
- (jj) **Control System Integrator** means a contractor retained by the City (under a different contract) to program and configure the water treatment plant SCADA system.
- (kk) **Systems Integrator** means Control Systems Integrator.
- (ll) **SCADA** means supervisor control and data acquisition.
- (mm) **TGS** means Manitoba Transportation and Government Service.

(nn) **MV means medium voltage.**

(oo) **WTP** means the Winnipeg Water Treatment Plant and includes the structure and all equipment and materials supplied and installed into the building, under multiple construction contracts, including portions of the Work provided under this Contract.

D3.2 The definitions of technical terms, abbreviations, and symbols will be those of the American Society for Testing and Materials, Canadian Standards Association and the applicable Codes and Standards. In the event of a dispute, the Contract Administrator's decision will be final.

D3.3 The Manufacturer and Manufacturer's Representative are not parties to this Contract. All work required from the Manufacturer and Manufacturer's Representative shall be provided and coordinated by the Contractor.

D3.4 Specialized terms relating to instrumentation and control and which are not explicitly defined herein shall be as defined in The Instrumentation Systems and Automation Society (ISA) S51.1, National Electrical Manufacturer's Association (NEMA) Industrial Control and Systems (ICS) 1, American National Standards Institute (ANSI)/Institute of Electrical and Electronic Engineers (IEEE) Std 100, and the Communications Standard Dictionary, by Martin H. Weik.

#### **D4. CONTRACT ADMINISTRATOR**

D4.1 The Contract Administrator is UMA Projects (CM) Ltd., represented by:

Bill Richert, P. Eng.  
1479 Buffalo Place  
Winnipeg, Manitoba R3T 1L7  
Telephone No. (204) 986-6053  
Facsimile No. (204) 986-8393  
e-mail address: bill.richert@uma.aecom.com

#### **D5. NOTICES**

D5.1 GC.7.05 is hereby amended to delete reference to "registered mail" and to replace same with "ordinary mail".

D5.2 GC.7.05 is further amended hereby to include delivery by facsimile transmission (fax) as an acceptable means of delivering notices, consents, approvals, statements, authorizations, documents or other communications required or permitted to be given under this Contract. Deliveries by fax will be deemed to have been received on the day of delivery, if a business day, or if not a business day, on the business day next following the day of delivery.

D5.3 Further to GC.7.05, all notices, consents, approvals, statements, authorizations, documents or other communications to the City, except as expressly otherwise required in D5.4, D5.5 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.

D5.4 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 Administrative Officer Secretariat  
Administration Building, 3rd Floor  
510 Main Street  
Winnipeg MB R3B 1B9  
Facsimile No.: (204) 949-1174

- D5.5 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  
Corporate Services Department  
Legal Services Division  
185 King Street, 3rd Floor  
Winnipeg MB R3B 1J1  
Facsimile No.: (204) 947-9155

## **D6. INDEMNITY**

- D6.1 Notwithstanding GC.7.03, the Contractor shall save harmless and indemnify the City for twice the contract price plus two (2) million dollars against all costs, damages or expenses arising from actions, claims, demands and proceedings, by whomsoever brought, made or taken as a result of acts or omissions of the Contractor, his/her Subcontractors, employees or agents in the performance or purported performance of the Work, and more particularly from:

- (a) accidental injury to or death of any person whether retained by or in the employ of the Contractor or not, arising directly or indirectly by reason of the performance of the Work, or by reason of any trespass on or damage to property;
- (b) damage to any property owned in whole or in part by the City, or which the City by duty or custom is obliged, directly or indirectly, in any way or to any degree, to construct, repair or maintain;
- (c) damage to, or trespass or encroachment upon, property owned by persons other than the City;
- (d) failure to pay and obtain a discharge of a notice of claim for lien served upon the City in accordance with the requirements of The Builder's Liens Act;
- (e) failure to pay a Workers Compensation assessment, or Federal or Provincial taxes;
- (f) unauthorized use of any design, device, material or process covered by letters patent, copyright, trademark or trade name in connection with the Work;
- (g) inaccuracies in any information provided to the City by the Contractor

## **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. WORKERS COMPENSATION**

- D8.1 The Contractor shall be registered with the Workers Compensation Board of Manitoba, shall provide and maintain Workers Compensation coverage throughout the term of the Contract, and shall provide the Contract Administrator with evidence thereof upon request.



## **D9. INSURANCE**

- D9.1 The City will provide and maintain the following Project Insurance Coverages:
- (a) Builder's Risk Insurance in the amount of one hundred percent (100%) of the total project cost.
    - (i) The Contractor shall be responsible for deductibles up to \$10,000.00 maximum of any one loss.
  - (b) Wrap-Up Liability Insurance in an amount of no less than 10 million dollars (\$10,000,000.00)
    - (i) The Contractor shall be responsible for deductibles up to \$10,000.00 maximum of any one loss..
  - (c) The City of Winnipeg will carry such insurance to cover all parties engaged in the Work in this Contract. Provision of this insurance by the City of Winnipeg is not intended in any way to relieve the Contractor from his obligations under the terms of the Contract. Specifically, losses relating to deductibles for insurance, as well as losses in excess of limits of coverage and any risk of loss that is not covered under the terms of the insurance provided by the City of Winnipeg remains with the Contractor.
- D9.2 The Contractor shall provide and maintain the following insurance coverage at all times during the performance of the Work:
- (a) Automobile liability insurance for owned and non-owned automobiles used for or in connection with the work in the amount of at least two million dollars (\$2,000,000.00).
    - (i) Deductibles shall be borne by the Contractor;
    - (ii) The Contractor shall not cancel, materially alter, or cause the policy to lapse without providing at least fifteen (15) Calendar Days prior written notice to the Contract Administrator;
    - (iii) The Contractor shall provide the Contract Administrator with evidence of insurance of the policy at least two (2) Business Days prior to the commencement of any Work on the Site but in no event later than seven (7) Calendar Days from notification of the award of Contract.
  - (b) The Contractor shall not cancel, materially alter, or cause each policy to lapse without providing at least fifteen (15) Calendar Days prior written notice to the Contract Administrator.

## **D10. PERFORMANCE SECURITY**

- D10.1 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 If the bid security provided in his Bid Submission was not a certified cheque or draft pursuant to B10.1(c), 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 letter of intent and prior to the commencement of any Work on the Site but in no event later than the date specified in GC.3.01 for the return of the executed Contract.

**D11. SUBCONTRACTOR LIST**

D11.1 The Contractor shall provide the Contract Administrator with a complete list of the Subcontractors whom the Contractor proposes to engage (Form J: Subcontractor List) at least two (2) Business Days prior to the commencement of any Work on the Site but in no event later than the date specified in GC.3.01 for the return of the executed Contract.

**D12. WORK SCHEDULE**

D12.1 The Contract Administrator has developed a Project Master Schedule for the project. This schedule will be available in the offices of the Contract Administrator and will be updated as required as the work progresses.

D12.2 The Contractor shall, within 5 business days of award of contract, prepare a detailed Contract Work Schedule for his work based on a critical path method (CPM) approach.

D12.3 The schedule shall conform to the Project Master Schedule and show, in a clear graphical manner, through the use of Gantt charts, in a maximum of weekly stages, the proposed progress of the main items, structures and subtrades of the contract and indicate the labour, construction crews, plant and equipment to be employed. Indicate the delivery date of major pieces of equipment to be supplied. The schedule shall be predicated on the completion of all work on or before the date of Substantial Performance.

D12.4 Upon acceptance by the Contract Administrator, distribute copies of the revised schedule to Subcontractors and other concerned parties.

D12.5 The Contract Work Schedule shall be updated as the work requires and submitted to the Contract Administrator.

D12.6 The Contractor shall instruct recipients to report to the Contractor immediately any problems anticipated by the timetable shown in the Contract Work Schedule.

D12.7 While it is intended that the Contractor shall be allowed, in general, to carry on the Contract in accordance with such general plans as may appear to him to be most desirable, the Contract Administrator, at his discretion, may direct the order in which, and points at which, the work shall be undertaken.

D12.8 This control shall be exercised in the interests of the City so that the work or other Contractors who may be working on the site may be coordinated with the work on this Contract. A program of work will be drawn up and agreed to before the commencement of the Contract.

D12.9 The Contract Administrator shall be notified immediately when the work under the Contract Work Schedule will adversely affect the work of other Contractors and the critical path of the Project Master Schedule as the work under the Contractor's Contract Work Schedule is an integral part of the Project Master Schedule.

D12.10 The Contractor shall be familiar with all other Contract Work Schedules as contracted by the City with other Contractors and the critical path of the Project Master Schedule.

### **D13. SECURITY CLEARANCE**

- D13.1 Each individual proposed to perform Work on the Site shall be required to obtain a Criminal Record Check Search Certificate from the Police Service having jurisdiction at his place of residence.
- D13.2 Prior to the commencement of any Work, and during the term of the Contract if additional or replacement individuals are proposed to perform Work, the Contractor shall supply the Contract Administrator with a Criminal Record Search Certificate obtained not earlier than one (1) year prior to the Submission Deadline, or a certified true copy thereof, for each individual proposed to perform Work within City facilities or on private property.
- D13.3 Any individual for whom a Criminal Record Search Certificate is not provided, or for whom a Criminal Record Search Certificate indicates any convictions or pending charges related to property offences or crimes against another person, will not be permitted to perform any Work within City facilities or on private property.
- D13.4 Any Criminal Record Search Certificate obtained thereby will be deemed valid for the duration of the Contract subject to a repeated records search as hereinafter specified.
- D13.5 Notwithstanding the foregoing, at any time during the term of the Contract, the City may, at its sole discretion and acting reasonably, require an updated criminal records search. Any individual who fails to provide a satisfactory Criminal Record Search Certificate as a result of a repeated criminal records search will not be permitted to continue to perform Work under the Contract within City facilities or on private property.

### **SCHEDULE OF WORK**

#### **D14. COMMENCEMENT**

- D14.1 The Contractor shall not commence any Work until he is in receipt of a letter of intent from the Award Authority authorizing the commencement of the Work.
- D14.2 The Contractor shall not commence any Work on the Site until:
- (a) the Contract Administrator has confirmed receipt and approval of:
    - (i) evidence that the Contractor is 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;
    - (ii) evidence of the workers compensation coverage specified in D8;
    - (iii) evidence of the insurance specified in D9;
    - (iv) the performance security specified in D10;
    - (v) the Subcontractor list specified in D11;
    - (vi) the detailed work schedule specified in D12; and
    - (vii) the security clearances specified in D13.
  - (b) the Contractor has attended a meeting with the Contract Administrator, or the Contract Administrator has waived the requirement for a meeting. This meeting shall take place in Winnipeg, Manitoba approximately 10 days after the Award.

#### **D15. CRITICAL STAGES**

- D15.1 The Contractor shall achieve critical stages of the Work in accordance with the following requirements:

- (a) The short circuit study shall be completed within 20 Business Days of the Award of Contract.
- (b) Shop Drawings: Acceptable Shop Drawings for all Major Equipment shall be completed within 50 Business Days of the Award of the Contract. Shop drawing completion shall not be achieved until drawings are reviewed by the Contract Administrator.
- (c) Delivery:
  - (i) Delivery of goods to the Site shall begin no earlier than December 1, 2006 and be completed no later than January 31, 2007,
  - (ii) The detailed delivery schedule will be based on the Installation Contractor's and the City's requirements and will be coordinated by the Contract Administrator, and included in the Contract Work Schedule. The Goods shall be supplied into the care of the Installation Contractor in accordance with this schedule,
  - (iii) Equipment delivery shall be considered complete upon the issuance of Form 100: Certificate of Equipment Delivery and Form 101: Certificate of Readiness to Install. A separate form shall be provided for each major component. These forms included in Section 01650.
- (d) Satisfactory Installation: The Contractor shall provide support to the Installation Contractor as required to achieve satisfactory installation of all equipment by February 10, 2007.
  - (i) This support shall include (but is not limited to) providing a qualified representative on Site as required to assist the Installation Contractor in achieving satisfactory installation of the Goods supplied under this Contract.
  - (ii) Satisfactory installation shall be considered complete upon the issuance of Form 102: Certificate of Satisfactory Installation. A separate form is required for each piece of Major Equipment.
- (e) Satisfactory Performance Verification and Training: Performance Verification and Training shall begin no earlier than March 31, 2007 and shall be completed on or before achieving Substantial Performance.
  - (i) The Contract Administrator will coordinate the Performance Verification and training to coincide with the project commissioning schedule and will provide the Contractor a minimum of thirty (30) Calendar Days written notification of the acceptable date for the start of Performance Verification and training.
  - (ii) During the Performance Verification and training period the Contractor shall provide qualified representation on Site as required to assist the Installation Contractor in achieving and demonstrating satisfactory performance of the goods supplied under this Contract.
  - (iii) Satisfactory Performance Verification and training shall be considered complete upon the issuance of Form 103: Certificate of Equipment Satisfactory Performance and Form T1: Certificate of Satisfactory Training.

D15.2 The Contract Administrator will endeavour to review Shop Drawings within ten (10) Business Days upon their submission. If review is not made within that time period, Contract dates specified in D15.1(b) will be extended by an equivalent number of Business Days.

D15.3 All Shop Drawings submitted pursuant to D15.1(a) shall be provided in a single submission.

## **D16. SUBSTANTIAL PERFORMANCE**

D16.1 The Contractor shall achieve Substantial Performance by April 30, 2007.

D16.2 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.

D16.3 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.

D16.4 Substantial Performance cannot be achieved without completion of Forms 103 and T1 for all Major Equipment supplied under this Contract.

#### **D17. TOTAL PERFORMANCE**

D17.1 The Contractor shall achieve Total Performance by June 30, 2007.

D17.2 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.

D17.3 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.

#### **D18. LIQUIDATED DAMAGES**

D18.1 If the Contractor fails to achieve critical stages, Substantial Performance or Total Performance in accordance with the Contract by the days fixed herein for same, the Contractor shall pay the City the following amounts per Calendar Day for each and every Calendar Day following the days fixed herein for same during which such failure continues:

- (a) Short circuit study in accordance with D15.1(a) – two thousand, six hundred dollars (\$2,600.00);
- (b) Acceptable Shop Drawings in accordance with D15.1(b) – two thousand, six hundred dollars (\$2,600.00);
- (c) Delivery in accordance with D15.1(c) – two thousand, six hundred dollars (\$2,600.00);
- (d) Satisfactory installation in accordance with D15.1(d) - zero dollars (\$0.00);
- (e) Substantial Performance – two thousand, six hundred dollars (\$2,600.00);
- (f) Total Performance – six hundred dollars (\$600).

D18.2 The amounts specified for liquidated damages in D18.1 is based on a genuine pre-estimate of the City's losses in the event that the Contractor does not achieve critical stages, Substantial Performance or Total Performance by the days fixed herein for same.

D18.3 The City may reduce any payment to the Contractor by the amount of any liquidated damages assessed.

D18.4 The City will not pay a bonus for performance if the Contractor reaches critical stages, Substantial Performance or Total Performance earlier than the dates specified herein.

## MEASUREMENT AND PAYMENT

### D19. PAYMENT SCHEDULE

- D19.1 Further to GC.9.01 and GC.9.03, payment shall be in accordance with the following payment schedule:
- (a) Measurement and payment for the Lump Sum Price as listed in Form B: Prices, shall include all Shop Drawings, equipment, accessories, spare parts, delivery, installation support, performance verification and training.
    - (i) One (1) percent of the Lump Sum Price will be paid upon the issuance of the short circuit study.
    - (ii) One (1) percent of the Lump Sum Price will be paid upon the issuance of Certified Shop Drawings for the entire scope of this supply Contract.
    - (iii) Seventy-three (73) percent of the Lump Sum Price will be paid upon issuance of Forms 100: Certificate of Equipment Delivery and 101: Certificate of Readiness to Install and for transference of title to the City of Winnipeg for all major equipment.
    - (iv) A further ten (10) percent of the Lump Sum Price will be paid upon issuance of Form 102: Certificate of Satisfactory Installation.
    - (v) A further ten (10) percent of the Lump Sum Price will be paid upon the issuance of Form 103: Certificate of Equipment Satisfactory Performance and
    - (vi) A further five (5) percent of the Lump Sum Price will be paid upon the issuance of Form T1: Certificate of Satisfactory Training.
  - (b) Further to GC.9.03:
    - (i) Any payment made by the City to the Contractor on account of a progress estimate shall be less any holdback required to be made by The Builders' Liens Act, and such holdbacks or other amounts which the City is entitled to withhold pursuant to the Contract;
    - (ii) Payment on account of the final progress estimate, including the holdback made by the City pursuant to The Builders' Liens Act, shall be paid to the Contractor when the time for filing liens or trust claims has elapsed, unless the City is in receipt of a lien or trust claim.

## WARRANTY

### D20. WARRANTY

- D20.1 Further to GC.10.01, if a defect or deficiency prevents the full and normal use or operation of the Work or any portion thereof, for purposes of calculating the warranty period, time shall be deemed to cease to elapse for the defective or deficient portion, and for any portion of the Work whose use or operation is prevented by such defect or deficiency, as of the date on which the defect or deficiency is observed or the use or operation is prevented and shall begin to run again when the defect or deficiency has been corrected or the Work may be used or operated to the satisfaction of the Contract Administrator.
- D20.2 Notwithstanding GC.10.01, GC.10.02 and D20.1, if any law of Manitoba or of the jurisdiction in which the Work was manufactured requires, or if the manufacturer provides, a longer warranty period or a warranty which is more extensive in its nature, then the provisions of such law or manufacturer's warranty shall apply.
- D20.3 New components which replace defective components under warranty shall have a warranty period identical to the warranty period that replaced component had at Total Performance. The warranty period for the new components shall begin on the date that they are performance tested and accepted by the City.

## **CONTROL OF WORK**

### **D21. PRIME CONTRACTOR – THE WORKPLACE SAFETY AND HEALTH ACT**

- D21.1 Further to GC6.26, UMA Projects (CM) Ltd. 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).
- D21.2 As Prime Contractor, UMA Projects (CM) Ltd. will administer a Project Safety and Health Management Plan. Compliance with this Plan will be mandatory for all personnel on the construction site and training and certification of all staff by the Prime Contractor's Safety Officer will be required.
- D21.3 The Water Treatment Program Project Health and Safety Management Plan is available on the City of Winnipeg, Corporate Finance, Materials Management Branch internet site at <http://www.winnipeg.ca/matmgt/projects>

**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 dated the

\_\_\_\_\_ day of \_\_\_\_\_, 20\_\_\_\_, for:

BID OPPORTUNITY NO. 682-2005

WINNIPEG WATER TREATMENT PROGRAM – SUPPLY OF STANDBY GENERATORS AND 5 KV SWITCHGEAR

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)

\_\_\_\_\_  
(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  
Corporate Services Department  
Legal Services Division  
185 King Street, 3rd Floor  
Winnipeg MB R3B 1J1

RE: PERFORMANCE SECURITY - BID OPPORTUNITY NO. 682-2005

WINNIPEG WATER TREATMENT PROGRAM – SUPPLY OF STANDBY GENERATORS AND 5 KV SWITCHGEAR

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. GENERAL

E1.1 These Specifications shall apply to the Work.

E1.2 The following are applicable to the Work:

#### Sections

| <u>Section</u>   | <u>Description</u>                               |
|--|--|
| <b><u>Division 01 – General Requirements</u></b>         |  |
| 01300  | Submittals                                       |
| 01400  | Quality Control                                  |
| 01650  | Equipment Installation                           |
| 01730  | Operation and Maintenance Manuals                |
| <b><u>Division 15 – Mechanical</u></b>                   |  |
| 15010  | General Mechanical Provisions                    |
| 15193  | Petroleum Products Distribution Systems          |
| 15461  | Outdoor Fuel Tanks and Accessories               |
| <b><u>Division 16 - Electrical</u></b>                   |  |
| 16010  | Electrical General Requirements                  |
| 16015  | Scope of Supply                                  |
| 16346  | Switchgear Assembly to 5kV                       |
| 16350  | Medium Voltage Circuit Breakers                  |
| 16405  | Coordination and Short Circuit Study             |
| 16431  | Metering and Switchboard Instruments             |
| 16432  | Instrument Transformer                           |
| 16450  | Grounding - Secondary                            |
| 16622  | Power Generation - Detail                        |
| 16627  | Automatic Load Transfer Equipment                |
| 16631  | Storage Batteries and Racks                      |
| 16635  | Battery Chargers                                 |
| <b><u>Division 17 – Instrumentation and Controls</u></b> |  |
| 17010  | Instrumentation and Control General Requirements |
| 17110  | Enclosures                                       |
| 17124  | Instrumentation Cable                            |
| 17130  | Power Supplies                                   |
| 17216  | Switches and Relays                              |
| 17275  | Miscellaneous Panel Devices                      |
| 17500  | Programmable Logic Controllers                   |
| 17501  | Operator Interface Requirements                  |

#### Drawings

| <u>Drawing No.</u> | <u>Description</u>                                   |
|--------------------|--|
| WG-E0001           | Electrical – Site Plan                               |
| WG-E0101           | Electrical – Generator Building – Floor Plan         |
| WG-E0401           | Electrical – Single Line Diagram – Main Distribution |

WG-E0402      Electrical – Single Line Diagram – Generator Switchboard

**E2.      GOODS**

- E2.1      The Contractor shall supply standby generators and 5 kV switchgear in accordance with the requirements hereinafter specified.

## **SUBMITTALS**

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### **1. SHOP DRAWINGS**

#### **1.1 General**

- .1 Arrange for the preparation of clearly identified Shop Drawings as specified or as the Contract Administrator may reasonably request. Shop Drawings are to clearly indicate materials, methods of construction, and attachment or anchorage, erection diagrams, connections, explanatory notes, and other information necessary for completion of the Work. Where articles or equipment attach or connect to other articles or equipment, clearly indicate that all such attachments and connections have been properly coordinated, regardless of the trade under which the adjacent articles or equipment will be supplied and installed. Shop Drawings are to indicate their relationship to design Drawings and Specifications. Notify the Contract Administrator of any deviations in Shop Drawings from the requirements of the Contract Documents to allow the Contract Administrator to assess the deviations.
- .2 Where all or part of the Shop Drawings are to be prepared under the stamp and seal of a Professional Engineer, the Contract Administrator will limit that review to an assessment of the completeness of the part of the submission so stamped and sealed.

#### **1.2 Electrical and Controls Installation Information**

- .1 Key information will be taken from Shop Drawings to prepare electrical and instrumentation drawings and/or layout drawings, control schematics, and interconnection wiring diagrams.

#### **1.3 Submission Requirements**

- .1 Coordinate each submission with requirements of the Work and Contract Documents. Individual submissions will not be reviewed until all related information is available.
- .2 Accompany submissions with a transmittal letter, in duplicate, containing:
  - .1 Date.
  - .2 Project title and number.
  - .3 Contractor's name and address
  - .4 Identification and quantity of each Shop Drawing product.
  - .5 Equipment tag number.
  - .6 Other pertinent data.
- .3 Submissions shall include:
  - .1 Date and revision dates.
  - .2 Project title and number.

## SUBMITTALS

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- .3 Name and address of:
  - .1 Contractor.
  - .2 Manufacturer.
- .4 Contractor's stamp, signed by Contractor's authorized representative, certifying approval of submissions, verification of field measurements and compliance with Contract Documents.
- .5 As required in the Specifications, the seal and signature of a Professional Engineer registered in the Province of Manitoba.
- .4 Details of appropriate portions of work as applicable:
  - .1 Fabrication.
  - .2 Layout showing dimensions including identified field dimensions and clearances.
  - .3 Setting or erection details.
  - .4 Capacities.
  - .5 Performance characteristics.
  - .6 Standards.
  - .7 Operating weight.
  - .8 Wiring diagrams.
  - .9 Single line and schematic diagrams.
  - .10 Method of control of equipment and its communication with the City's Supervisory Control and Data Acquisition (SCADA) system.

### **1.4 Drawings**

- .1 Original Drawings or modified standard Drawings provided by the Contractor to illustrate details of portions of work which are specific to project requirements.
- .2 Maximum sheet size: 850 x 1050 mm.
- .3 Submit six (6) prints and one (1) reproducible copy of Shop Drawings. The Contract Administrator shall return the reproducible copy with comments transcribed.
- .4 Cross-reference Shop Drawing information to applicable portions of the Contract Documents.



## SUBMITTALS

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- .5 Include reviewed Shop Drawings in all Operation and Maintenance (O&M) Manuals.

### **1.5 Product Data**

- .1 Product Data; Manufacturer's catalogue sheets, brochures, literature, performance charts, and diagrams used to illustrate standard manufactured products.
- .2 Submit six (6) copies of product data.
- .3 Sheet size: 215 x 280 mm.

### **1.6 Electronic Submittals**

- .1 Provide electronic copies of all submittals within sixty (60) business days of stamped "Reviewed" or "Reviewed as Modified".

### **1.7 Shop Drawing Review**

- .1 Shop Drawing review by the Contract Administrator is solely to ascertain conformance with the general design concept. Responsibility for the approval of detail design inherent in Shop Drawings rests with the Contractor and review by the Contract Administrator shall not imply such approval.
- .2 Review by the Contract Administrator shall not relieve the Contractor of his responsibility for errors or omissions in Shop Drawings or for proper completion of the Work in accordance with the Contract Documents.
- .3 Shop Drawings will be returned to the Contractor with one of the following notations:
  - .1 When stamped "REVIEWED", distribute additional copies as required for execution of the Work.
  - .2 When stamped "REVIEWED AS MODIFIED", ensure that all copies for use are modified and distributed, same as specified for "REVIEWED".
  - .3 When stamped "REVISE AND RE-SUBMIT", make the necessary revisions, as indicated, consistent with the Contract Documents and submit again for review.
  - .4 When stamped "NOT REVIEWED", submit other drawings, brochures, etc. for review consistent with the Contract Documents.
  - .5 Only Shop Drawings bearing "REVIEWED" or "REVIEWED AS MODIFIED" shall be used on the Work unless otherwise authorized by the Contract Administrator.
- .4 After submittals are stamped "REVIEWED" or "REVIEWED AS MODIFIED", no further revisions are permitted unless re-submitted to the Contract Administrator for further review.

### **SUBMITTALS**

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- .5 Any adjustments made on Shop Drawings by the Contract Administrator are not intended to change the Contract Price. If it is deemed that such adjustments affect the Contract Price, clearly state as such in writing prior to proceeding with fabrication and installation of Work.
- .6 Make changes in Shop Drawings which the Contract Administrator may require consistent with Contract Documents. When re-submitting, notify the Contract Administrator in writing of any revisions other than those requested by the Contract Administrator.
- .7 Shop Drawings indicating design requirements not included in the Contract Documents require the seal of a Professional Engineer, registered in the Province of Manitoba. If requested, submit engineering calculations for review, sealed by a Professional Engineer.

#### **1.8 Operating and Maintenance Manuals**

- .1 Refer to **Section 01730 – Operation and Maintenance Manuals**.

**END OF SECTION**

## QUALITY CONTROL

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### 1. CODES AND STANDARDS

- .1 In the case of a conflict or discrepancy between the Contract Documents and the governing standards, the more stringent requirements shall apply.
- .2 Unless the edition number and date are specified, the reference to the Manufacturer's and published codes, standards, and Specifications are to the latest edition published by the issuing authority, current at the date of submission deadline.
- .3 Reference standards and Specifications are quoted in this Specification to establish minimum standards. Work in quality exceeding these minimum standards conforms to the Contract.
- .4 Where reference is made to a Manufacturer's direction, instruction, or Specification it is deemed to include full information on storing, handling, preparing, mixing, installing, erecting, applying, or other matters concerning the products pertinent to their use and their relationship to the products with which they are incorporated.
- .5 Confine apparatus, the storage of products and the operations of workers to limits indicated by laws, ordinances, permits, and by directions of the Contract Administrator. Do not unreasonably encumber the premises with products.
- .6 Where reference is made to regulatory authorities, it includes all authorities who have, within their constituted powers, the right to enforce the laws of the place of Work.

### 2. TESTING AND QUALITY CONTROL

- .1 Provide to the Contract Administrator, when requested and consistent with progress of the Work, test results and designs specified in the Contract Documents or required by by-laws, statutes, and regulations relating to the Work and the preservation of public health, including the following:
  - .1 Inspection and testing performed exclusively for the Contractor's convenience
  - .2 Testing, adjusting, and balancing of generator equipment and systems, fuel storage and transfer equipment and systems, mechanical, electrical, and instrumentation and control (I&C) equipment and systems
- .2 The Contract Administrator will select and the City will pay for the services of a testing agency or laboratory for material quality control tests that are required but not specified. Tests required by by-laws, statutes, and regulations applicable to the Work are the responsibility of the Contractor.
- .3 Compliance and performance testing of equipment, pipe, conduit, wiring, and other items covered in other Divisions of this Specification are the responsibility of the Contractor, unless specified otherwise. The City may replicate any series of tests to provide random checks on the compliance and performance tests at the City's cost.

## QUALITY CONTROL

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- .4 Remove and replace products indicated in inspection and test reports as failing to comply with the Contract Documents.
- .5 Correct improper installation procedures reported in the inspection and test reports.
- .6 Pay the costs for the re-inspection and re-testing of replaced Work.
- .7 It is not the responsibility of the inspection and testing agents to supervise, instruct in current methods or accept or reject a part of the Work, but only to inspect, test, and to report conditions.
- .8 Notify the Contract Administrator and the appropriate inspection and testing agent not less than forty eight (48) hours prior to the commencement of the part of the Work to be inspected and tested.
- .9 Ensure the presence of the authorized inspection and testing agent at the commencement of the part of the Work specified to be inspected or tested.
- .10 Ensure the inspection and testing reports are issued promptly (normally within forty eight (48) hours), and that the Contract Administrator is notified forthwith if the report indicates improper conditions or procedures.
- .11 Cooperate with and provide facilities for the inspection and testing agents to perform their duties.
- .12 Provide proper facilities for the storage of specimens or samples at correct temperature, free from vibration or damage in accordance with the instruction of the inspection and testing agent and the governing standard.
- .13 Submit four (4) copies of each laboratory test report, unless specified otherwise, each copy signed by a responsible officer of the inspection and testing laboratory. Each report is to include:
  - .1 Date of issue
  - .2 Contract name and number
  - .3 Name and address of inspection and testing company
  - .4 Name and signature of inspector or tester
  - .5 Date of inspection or test
  - .6 Identification of the Product and Specification Section covering inspected or tested Work
  - .7 Location of the inspection or the location from which the tested Product was derived
  - .8 Type of the inspection or test

**QUALITY CONTROL**

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- .9 The remarks and observations on compliance with the Contract Documents
- .14 Correct defective Work within the Contract Time; the performing of such Work is not a cause for an extension of the Contract Time.

**END OF SECTION**

## EQUIPMENT INSTALLATION

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### 1. INTENT

- .1 This Section describes general requirements for equipment relating to supply, installation, testing, operation, and performance verification.

### 2. EXPERTISE AND RESPONSIBILITY

- .1 The Contract Administrator recognizes the expertise of the Contractor and the Manufacturer.
- .2 Should the Contract Administrator issue a Field Order, Change Order, or Instruction to change the Work which would, in the opinion of the Contractor, compromise the success or safety of the Work, then it shall be incumbent on the Contractor to notify in writing the Contract Administrator to this effect within two (2) days.

### 3. EQUIPMENT DELIVERY

- .1 The Installer shall be responsible for receiving, off-loading, and placing into storage all equipment at the Site. **Form 100** shall be completed.

### 4. INSTALLATION ASSISTANCE

- .1 Before commencing installation of equipment, the Installer shall arrange for the attendance of the Manufacturer's Representative to provide instructions in the methods, techniques, precautions, and any other information relevant to the successful installation of the equipment.
- .2 The Contractor shall inform the Contract Administrator, in writing, of the attendance at the Site of any Manufacturer's Representative for installation training at least fourteen (14) days prior to arrival.
- .3 When the Manufacturer's Representative is satisfied that the Installer is aware of all installation requirements, he shall so certify by completing **Form 101** attached to this Specification.
- .4 The completed form shall be delivered to the Contract Administrator prior to departure of the Manufacturer's Representative from the Site.
- .5 Installation of the equipment shall not commence until the Contract Administrator has advised that he has received the completed **Form 101**.
- .6 Separate copies of **Form 101** shall be used for different equipment.

## EQUIPMENT INSTALLATION

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### 5. INSTALLATION

- .1 If necessary, or if so directed by the Contract Administrator during the course of installation, the Installer shall contact the Manufacturer to receive clarification of installation procedures, direction, or any other additional information necessary to continue or complete the installation in an appropriate manner. The Contractor shall provide this installation assistance at his own cost.
- .2 If it is found necessary, or if so directed by the Contract Administrator, the Installer will contact the Contractor who shall arrange for the Manufacturer's Representative to visit the Site to provide assistance during installation, all at no cost to the City.
- .3 Prior to completing installation, the Installer shall inform the Contractor who shall arrange for the attendance at the Site of the Manufacturer's Representative to verify successful installation.
- .4 The Manufacturer's Representative shall conduct a detailed inspection of the installation including alignment, electrical connections, belt tensions, rotation direction, running clearances, lubrication, workmanship, relay settings, grounding, megger and hi-pot testing and all other items as required to ensure successful operation of the equipment.
- .5 The Manufacturer's Representative shall identify any outstanding deficiencies in the installation.
- .6 The deficiencies shall be rectified by the Installer and the Manufacturer's Representative shall re-inspect the installation, at the Contractor's cost.
- .7 When the Manufacturer's Representative accepts the installation, he shall certify the installation by completing **Form 102**, attached to this Specification.
- .8 Deliver the completed **Form 102** to the Contract Administrator prior to departure of the Manufacturer's Representative from the Site.
- .9 Tag the equipment with a 100 mm x 200 mm card stating "EQUIPMENT CHECKED. DO NOT RUN." stencilled in large black letters. Sign and date each card.
- .10 Provide separate copies of **Form 102** for different equipment.

### 6. OPERATION AND PERFORMANCE VERIFICATION

- .1 Equipment shall be subjected to a demonstration, running test, and performance tests after the installation has been verified and any identified deficiencies have been remedied.
- .2 The demonstration and running tests for the 5 kV switchgear and the demonstration and running tests for the standby generators shall be conducted separately. The performance tests shall be conducted as a complete system.

### EQUIPMENT INSTALLATION

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- .3 Inform the Contract Administrator at least fourteen (14) days in advance of conducting the tests and arrange for the attendance of the Manufacturer's Representative. The tests may be concurrent with the inspection of satisfactory installation if mutually agreed by the Installer, Contractor, and the Contract Administrator.
- .4 The Manufacturer's Representative shall conduct all necessary checks to equipment outlined in the Technical Specifications and if necessary, advise the Installer of any Work needed prior to confirming the equipment is ready to run.
- .5 The Contractor shall then operate the equipment to demonstrate to himself the operation of the equipment and any required ancillary services. Any remedial measures required to ensure satisfactory operation shall be promptly undertaken.
- .6 The Contractor shall then notify the Contract Administrator of his readiness to demonstrate the operation of the equipment. The Contract Administrator will attend, as expeditiously as possible.
- .7 With the assistance of the Manufacturer's Representative, the Contractor shall demonstrate that the 5 kV switchgear is properly installed. The Contractor shall submit an installation check list to the Contract Administrator at least fourteen (14) days in advance. The check list shall be completed in the presence of the Contract Administrator.
- .8 Switchgear demonstration and running tests:
  - .1 Prior to running tests the Contractor shall conduct coordination study to determine setting of all protective devices in the 4160 V and 600 V distribution system. All protective devices in the 4160 V and 600 V distribution system shall be set and verified by the Contractor prior to the commencement of the running tests.
  - .2 The Contractor shall submit a testing schedule identifying all individual test procedures for the 5 kV switchgear to the Contract Administrator at least fourteen (14) days in advance of conducting the running tests. The Contract Administrator reserves the right to add tests to the schedule at this time and during the testing procedure. At the completion of the running tests the switchgear shall remain energized. The equipment will be operated by the Contract Administrator for the power supply to the Water Treatment Plant and associated works. The automatic load transfer features shall be disabled.
  - .3 With the assistance of the Manufacturer's Representative, the Contractor shall demonstrate that the standby generators are properly installed. The Contractor shall submit an installation check list to the Contract Administrator for his review at least fourteen (14) days in advance. The check list shall include items such as alignment, piping connections, electrical connections. The check list shall be completed in the presence of the Contract Administrator. If appropriate, code certifications provided.
- .9 Generator demonstration and running tests:



## EQUIPMENT INSTALLATION

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- .1 Each generator and associated equipment shall then be run for one (1) hour fully loaded. The Contractor shall provide load banks if sufficient electrical loads are not available On-Site at the time of testing. Local controls shall be satisfactorily verified by cycling the equipment through several start-stop operations, modulating its output, or some combination. Operating parameters such as temperature, pressure, voltage, vibration, etc., shall be checked to ensure that they are within the specified or Manufacturer's recommended limits, whichever is more stringent.
  - .2 On satisfactory completion of the one (1) hour demonstration, the equipment shall be stopped and critical parameters, such as temperature, shall be rechecked.
  - .3 The eight (8) hour running tests of the generators shall be conducted during a period of high ambient temperature. It is anticipated that these running test will be conducted in summer 2007 when ambient temperature is relatively high. The Contract Administrator shall schedule the running test and provide three (3) days notice to the Contractor based on weather condition forecasts to ensure the ambient temperature is near its peak value. The purpose of this test to test the generators under extreme temperature condition.
  - .4 The Contractor shall submit a testing schedule for the standby generators to the Contract Administrator at least fourteen (14) days in advance of conducting the running tests. The schedule shall include the testing as outlined in **Section 16622 – Power Generation Detail**. The Contract Administrator reserves the right to add tests to the schedule at this time and during the testing procedure. All generators (two or three) shall be running and tested at the same time. The Contractor shall provide load banks if sufficient electrical loads are not available On-Site at the time of testing.
- .10 Performance tests:
- .1 Performance tests of the 5 kV switchgear and the standby generators shall be conducted concurrently. Testing shall be scheduled by the Contract Administrator and fourteen (14) days notice to the Contractor will be provided. It is anticipated that the performance testing will occur subsequent to the successful completion of the Water Treatment Plant and associated works, approximately in the fall of 2007. The Performance tests of the equipment shall be carried out jointly with the City's Supervisory Control and Data Acquisition (SCADA) programming team. Performance tests shall also be attended by the City's operations staff as part of the acceptance procedure. Testing procedures and conditions shall be agreed to among the Contractor, Contract Administrator, and the City based on information in the Specification. The Contract Administrator is the final arbiter. However, the Contractor is solely responsible for conducting the tests.
  - .2 Performance tests shall be as dictated in the technical Specifications for each item of equipment or as reasonably required by the Contract Administrator to prove adherence to the requirements listed in the Specification.
  - .3 The Contractor shall submit the results of the performance tests to the Contract Administrator, documented and summarized in a format acceptable to the Contract Administrator. The Contract Administrator reserves the right to request additional

## EQUIPMENT INSTALLATION

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testing. No equipment shall be accepted and handed over to the City prior to the satisfactory completion of the performance test(s) and receipt of the test reports.

- .11 All fuel, temporary power, heating, or any other ancillary services required to complete the initial demonstration, running test, and performance tests are the responsibility of the Installer.
- .12 Should the initial demonstration, running test, or performance tests reveal any defects, then those defects shall be promptly rectified and the demonstration, running tests, and/or performance tests shall be repeated to the satisfaction of the Contract Administrator. If the defects are attributed to the Contractor, additional costs incurred by the Installer, the Contract Administrator, or the City, due to repeat demonstration, running tests, and/or performance tests shall be the responsibility of the Contractor.
- .13 On successful completion of the demonstration, running test, and performance tests, **Form 103** attached to this Specification shall be signed by the Manufacturer's Representative, the Installer, and the Contract Administrator.
- .14 When the Contract Administrator confirms that **Form 103** and **Form T1** have been completed for all equipment in the plant and they are ready to operate in concert, the twenty eight (28) day commissioning period shall commence. The switchgear shall operate continuously and each generator will be exercised for one (1) hour weekly over the twenty eight (28) day period without experiencing a critical failure. A critical failure is defined as one that prevents the equipment from operating for an eight (8) hour period or that presents a safety hazard. Upon completion of the twenty eight (28) day commissioning period, the equipment shall be deemed to have been handed-over and accepted by the Contract Administrator, unless the Contractor or Manufacturer's Representative is notified otherwise. During the commissioning period the equipment will be operated by others.

### 7. OPERATOR TRAINING

- .1 For equipment specified to include training, arrange for the attendance of the Manufacturer's Representative to provide classroom training session(s) to operation and maintenance (O&M) staff.
- .2 The training sessions shall last three (3) days each, unless otherwise specified. The training sessions shall be given twice, to allow the City's staff to attend either session. The training sessions shall be given during the three (3) week period preceding the start of the performance testing.
- .3 Coordinate the training session(s) with the Contract Administrator.
- .4 Prepare a draft handout taking the form of the relevant sections of the O&M Manual supplemented with any other information needed to fully explain the equipment operation.
- .5 Prepare a draft agenda outlining the content of the training sessions. Allow half an hour at the beginning of the first period for the Contract Administrator to provide a summary of the

## EQUIPMENT INSTALLATION

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design intent relating to that equipment. Following the engineering design overview, provide (as a minimum) information covering major equipment operation, mechanical and instrumentation engineering.

- .6 Submit the draft handout and draft agenda to the Contract Administrator for review. Upon obtaining the Contract Administrator's acceptance, prepare ten (10) copies of the handout and submit to the Contract Administrator.
- .7 Inform the Contract Administrator of any requirements for audio-visual aids five (5) days before the training session.
- .8 The Manufacturers' Representative shall provide five (5) sets of training seminar manuals in similar format to the O&M Manuals prior to the training session. In addition, the Manufacturers' Representative shall be responsible to document each training session with a detailed set of minutes and video each session. The Manufacturers' Representative shall provide five (5) copies of the training video on DVD.
- .9 Upon completion of training, the Contractor shall issue **Form T1: Certificate of Satisfactory Training**, complete with all required signatures.

**EQUIPMENT INSTALLATION**

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**CERTIFICATE OF EQUIPMENT DELIVERY  
FORM 100**

We certify that the equipment listed below has been delivered into the care of the Installer. The equipment has been found to be in satisfactory condition. No defects in the equipment were found.

**PROJECT:** \_\_\_\_\_

**ITEM OF EQUIPMENT:** \_\_\_\_\_

\_\_\_\_\_

**TAG NO:** \_\_\_\_\_

**REFERENCE  
SPECIFICATION:** \_\_\_\_\_

\_\_\_\_\_  
(Authorized Signing Representative of the Contractor)

\_\_\_\_\_  
Date

\_\_\_\_\_  
(Authorized Signing Representative of Installer)

\_\_\_\_\_  
Date

\_\_\_\_\_  
(Authorized Signing Representative of the Contract Administrator)

\_\_\_\_\_  
Date

**EQUIPMENT INSTALLATION**

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**CERTIFICATE OF READINESS TO INSTALL  
FORM 101**

I have familiarized the Installer of the specific installation requirements related to the equipment listed below and am satisfied that he understands the required procedures.

**PROJECT:** \_\_\_\_\_

**ITEM OF EQUIPMENT:** \_\_\_\_\_

**TAG NO:** \_\_\_\_\_

**REFERENCE  
SPECIFICATION:** \_\_\_\_\_

---

(Authorized Signing Representative of the Manufacturer)

\_\_\_\_\_ Date

I certify that I have received satisfactory installation instructions from the equipment Manufacturer/Contractor.

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(Authorized Signing Representative of the Installer)

\_\_\_\_\_ Date

**EQUIPMENT INSTALLATION**

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**CERTIFICATE OF SATISFACTORY INSTALLATION  
FORM 102**

I have completed my check and inspection of the installation listed below and confirm that it is satisfactory and that defects have been remedied to my satisfaction except any as noted below:

**PROJECT:** \_\_\_\_\_

**ITEM OF EQUIPMENT:** \_\_\_\_\_

**TAG NO:** \_\_\_\_\_

**REFERENCE  
SPECIFICATION:** \_\_\_\_\_

**OUTSTANDING DEFECTS:** \_\_\_\_\_

\_\_\_\_\_  
(Authorized Signing Representative of the Manufacturer)

\_\_\_\_\_  
Date

\_\_\_\_\_  
(Authorized Signing Representative of the Installer)

\_\_\_\_\_  
Date

**EQUIPMENT INSTALLATION**

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**CERTIFICATE OF EQUIPMENT SATISFACTORY PERFORMANCE  
FORM 103**

We certify that the equipment listed below has been continuously operated for at least five (5) consecutive days and that the equipment operates satisfactorily and meets its specified operating criteria. No defects in the equipment were found. The equipment is therefore classed as “conforming”.

**PROJECT:** \_\_\_\_\_

**ITEM OF EQUIPMENT:** \_\_\_\_\_

**TAG NO:** \_\_\_\_\_

**REFERENCE  
SPECIFICATION:** \_\_\_\_\_

\_\_\_\_\_  
(Authorized Signing Representative of the Manufacturer)

\_\_\_\_\_  
Date

\_\_\_\_\_  
(Authorized Signing Representative of the Installer)

\_\_\_\_\_  
Date

\_\_\_\_\_  
(Authorized Signing Representative of the Contract Administrator)

\_\_\_\_\_  
Date

1. Acknowledgement of Receipt of O&M Manuals.

\_\_\_\_\_  
(Authorized Signing Representative of the City)

\_\_\_\_\_  
Date

**EQUIPMENT INSTALLATION**

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**CERTIFICATE OF SATISFACTORY TRAINING  
FORM T1**

We certify that the initial training for the equipment listed below has been provided as per the Specifications.

**PROJECT:** \_\_\_\_\_

**ITEM OF EQUIPMENT:** \_\_\_\_\_

\_\_\_\_\_

**TAG NO:** \_\_\_\_\_

**REFERENCE  
SPECIFICATION:** \_\_\_\_\_

\_\_\_\_\_  
(Trainer)

\_\_\_\_\_  
Date

\_\_\_\_\_  
(Authorized Signing Representative of the Installer)

\_\_\_\_\_  
Date

\_\_\_\_\_  
(Authorized Signing Representative of the Contract Administrator)

\_\_\_\_\_  
Date

**END OF SECTION**



**OPERATION AND MAINTENANCE MANUALS**

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**1. DESCRIPTION**

- .1 This Section supplements the requirements for the provision of Operation and Maintenance (O&M) Manuals as described in **Section 01300 – Submittals**.
- .2 Furnish complete operations manuals and maintenance information as specified in this Section for installation, check-out, operation, maintenance, and lubrication requirements for each unit of mechanical, electrical, and instrumentation equipment or system and each instrument.
- .3 Customize the operations manuals and maintenance information to describe the equipment actually furnished. Do not include extraneous data for models, options, or sizes not furnished (cross out or remove if required). When more than one model or size of equipment type is furnished, show the information pertaining to each model, option, or size.
- .4 Assemble, coordinate, bind, and index required data into an O&M Manual.
- .5 Three (3) draft copies of the manuals shall be submitted a minimum of sixty (60) days prior to Substantial Performance of the Work for review and comments. A maximum of eight (8) weeks after review, twelve (12) copies of the final manuals shall be supplied.
- .6 In addition to the twelve (12) hard copies, submit an electronic version of the O&M Manual.
- .7 Materials: Label each Section with tabs protected with celluloid covers, fastened to hard paper dividing sheets.
- .8 Type lists and notes.
- .9 Drawings, diagrams and Manufacturer's literature must be legible. Drawings larger than 280 x 430 mm must be folded and placed inside plastic pockets.

**2. OPERATION AND MAINTENANCE MANUAL CONTENTS AND ORGANIZATION**

- .1 Provide the Manufacturer's standard O&M manuals for the equipment or instruments supplied. If the Manufacturer's standard manuals do not contain all the required information, provide the missing information in supplementary documents and Drawings inserted behind appropriate tabs in the manual binder.
- .2 When more than one (1) piece of identical equipment or instruments are supplied, provide only one (1) set of operations manuals.
- .3 One (1) set of operations manuals may be provided when more than one (1) piece of similar equipment or instruments are supplied, such as different sizes of the same model, and all similar pieces are covered in the same standard Manufacturer's O&M manual.
- .4 When similar equipment or instruments are provided by the same Manufacturer, but are not covered in the same standard Manufacturer's O&M manual, their specific manuals may be

**OPERATION AND MAINTENANCE MANUALS**

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bound in the same three (3)-ring binder. Separate specific manuals with tab dividers labelled with the appropriate equipment numbers.

- .5 Provide a cover sheet, bound as the first page of each manual, with the following information:
  - .1 Contract name and number.
  - .2 Equipment number or, if more than one (1) piece of equipment is provided, equipment numbers for equipment or instruments covered by the manual. Include functional description of equipment after each number.
- .6 Provide a table of contents listing the contents of the manual and identifying where specific information can be located.
- .7 Insert the specific information described below in the O&M manuals in a format similar to that listed:
  - .1 Tab 1 – General Information
    - .1 Functional title of the system, equipment, material, or instrument.
    - .2 Relevant Specification Section number and Drawing reference.
    - .3 Address and telephone number of the Manufacturer and the nearest Manufacturer's Representative.
  - .2 Tab 2 - Equipment Data
    - .1 Insert Specification Section and completed Equipment and Instrumentation Data sheets for equipment supplied. Attach all addenda, change orders, and change directives that refer to that specific item of equipment.
  - .3 Tab 3 – Operation Information
    - .1 Include the Manufacturer's recommended step-by-step procedures for starting and stopping under normal and emergency operation. Include all specified modes of operation including recommended operation after the assembly or equipment has been in long-term storage.
    - .2 Provide control diagrams with data and information to explain operation and control of systems and specific equipment. Identify normal operating setpoints and alarm conditions.
    - .3 Provide technical information on all alarms and monitoring devices provided with the equipment.
    - .4 Provide troubleshooting information. Clearly identify which problems to look for and how to solve them.

**OPERATION AND MAINTENANCE MANUALS**

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- .4 Tab 4 - Technical Data
  - .1 Insert Manufacturer's technical specification and data sheets.
  - .2 Insert Manufacturer's certified performance and calibration curves for the equipment and instruments.
- .5 Tab 5 - Maintenance Information
  - .1 Include the description and schedule for all Manufacturers' recommended routine preventative maintenance procedures including specific lubrication recommendations. Indicate whether procedure is to be done daily, weekly, monthly, quarterly, semi-annually, annually, or fill in hours of operation.
- .6 Tab 6 - Maintenance Instructions
  - .1 Provide requirements to set up and check out each system for use. Include all required and recommended step-by-step inspections, lubrications, adjustments, alignments, balancing, and calibrations. Include protective device settings, warnings, and cautions to prevent equipment damage and to insure personnel safety.
  - .2 Provide Manufacturer's description of routine preventive maintenance, inspections, tests, and adjustments required to ensure proper and economical operation and to minimize corrective maintenance and repair.
  - .3 Provide Manufacturer's recommendations on procedures and instructions for correcting problems and making repairs.
  - .4 Provide step-by-step procedures to isolate the cause of typical malfunctions. Describe clearly why the checkout is performed and what conditions are to be sought. Identify tests or inspections and test equipment required to determine whether parts and equipment may be reused or require replacement.
  - .5 Provide step-by-step procedures and list special required tools and supplies for removal, replacement, disassembly, and assembly of components, assemblies, subassemblies, accessories, and attachments. Provide tolerances, dimensions, settings, and adjustments required.
- .7 Tab 7 - Assembly Drawings
  - .1 Provide Drawings which completely document the equipment, assembly, subassembly, or material for which the instruction is written. Provide the following Drawings as applicable: fabrication details, wiring and connection diagrams, electrical and piping schematics, block or logic diagrams, Shop Drawings, installation Drawings, layout and dimension Drawings, and electrical component fabrication Drawings.

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**OPERATION AND MAINTENANCE MANUALS**

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.2 Provide clear and legible illustrations, Drawings, and exploded views to enable easy identification of the items. When illustrations omit the part numbers and description, both the illustrations and separate listing shall show the index, reference, or key number which will cross-reference the illustrated part to the listed part. Parts shown in the listings shall be grouped by components, assemblies, and subassemblies.

.8 Tab 8 - Bills of Materials

.1 Provide a clear, legible copy of the Bill of Materials that was shipped with the equipment. The Bill of Materials should list all equipment, instruments, components, accessories, tools, and other items that were shipped with the equipment.

.9 Tab 9 - Lubrication Data

.1 Provide a table showing recommended lubricants for specific temperature ranges and applications.

.2 Provide charts with a schematic diagram of the equipment showing lubrication points, recommended types and grades of lubricants, and capacities.

.3 If the equipment or instrument is not lubricated, add a sheet under this Tab with the words "Not Applicable".

**3. FIELD CHANGES**

.1 Following the acceptable installation and operation of an equipment item, modify and supplement the item's instructions and procedures to reflect any field changes or information requiring field data.

**4. COMMISSIONING DATA**

.1 Provide in hard cover three (3)-ring binders for 215 x 280 mm paper labelled "Commissioning Data" one (1) copy of:

.1 All completed equipment testing and commissioning forms.

.2 All completed equipment checklists and performance reports, including noise and vibration analysis, instrumentation calibration data, and all other relevant information.

.3 All system performance reports

**OPERATION AND MAINTENANCE MANUALS**

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**5. WARRANTIES**

- .1 Provide in hard cover three (3)-ring binders for 215 x 280 mm paper labelled "Warranties" one (1) copy of:
  - .1 Manufacturers' standard Warrants and Guarantees. Include the name and telephone number of the contact person. Indicate the time frame of each Warrant or Guarantee on the list.

**END OF SECTION**

**GENERAL MECHANICAL PROVISIONS**

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**1. GENERAL**

**1.1 Intent**

- .1 Provide complete, fully tested and operational mechanical systems to meet the requirements described herein and in complete accord with applicable codes and ordinances.
- .2 Contract documents and Drawings of this Division are diagrammatic and approximately to scale unless detailed otherwise.

**1.2 Quality of Work**

- .1 All Work shall be by qualified tradesmen with valid Provincial Trade Qualification Certificates. Spot checks will be made by the Contract Administrator.
- .2 Work which does not conform to referenced standards may be rejected by the Contract Administrator. The Contractor shall redo rejected Work to the accepted standard at no cost to the City.

**1.3 Metric Conversion**

- .1 All units in this Division are expressed in SI units.
- .2 Submit all Shop Drawings and maintenance manuals in SI units.
- .3 On all submittals (Shop Drawings etc.) use the same SI units as stated in the Specification.
- .4 Equivalent Nominal Diameters of Pipes - Metric and Imperial:
  - .1 Where pipes are specified with metric dimensions and Imperial sized pipes are available, provide equivalent nominal imperial sized pipe as indicated in the table, and provide at no extra cost adapters to ensure compatible connections to all metric sized fittings, equipment, and piping.
  - .2 When Canadian Standards Association (CSA) approved SI Metric pipes are provided, the Contractor shall provide at no extra cost adapters to ensure compatible connections between the SI Metric pipes and all new and existing pipes, fittings, and equipment.

| <b>Pipe Sizes - mm (inches)</b> |            |          |
|---------------------------------|------------|----------|
| 3 (1/8)                         | 30 (1-1/4) | 125 (5)  |
| 6 (1/4)                         | 40 (1-1/2) | 150 (6)  |
| 10 (3/8)                        | 50 (2)     | 200 (8)  |
| 15 (1/2)                        | 65 (2-1/2) | 250 (10) |
| 20 (3/4)                        | 75 (3)     | 300 (12) |
| 25 (1)                          | 100 (4)    |          |

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**GENERAL MECHANICAL PROVISIONS**

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**1.4 Shop Drawings**

- .1 Submit Shop Drawings in accordance with **Section 01300 – Submittals**.
- .2 Identify materials and equipment by Manufacturer, trade name, and model number. Include copies of applicable brochure or catalogue material. Do not assume applicable catalogues are available in the Contract Administrator's office. Maintenance and operating (O&M) manuals are not suitable submittal material.
- .3 Clearly mark submittal material using arrows, underlining or circling to show differences from specified, e.g. ratings, capacities and options being proposed. Cross out non-applicable material. Specifically note on the submittal specified features such as special tank linings, pumps seals materials or painting.
- .4 Include weights, dimensional, and technical data sufficient to check if equipment meets requirements. Include wiring, piping, and service connection data and motor sizes.
- .5 Installed materials and equipment shall meet specified requirements regardless of whether or not Shop Drawings are reviewed by the Contract Administrator.

**1.5 Equipment and Materials**

- .1 Materials and equipment installed shall be new, full weight and of quality specified.
- .2 Each major component of equipment shall bear Manufacturer's name, address, catalogue and serial number in a conspicuous place.
- .3 Where two (2) or more products of the same type are required, products shall be of the same Manufacturer.

**1.6 Equipment Protection and Clean-Up**

- .1 Protect equipment and materials in storage prior to delivery.. Leave factory covers in place. Take special precautions to prevent entry of foreign material into working parts of piping and duct systems.
- .2 Protect equipment with polyethylene covers and crates.
- .3 Operate, drain, and flush out unsealed bearings and refill with new change of oil, before final acceptance.
- .4 Thoroughly clean piping, ducts and equipment of dirt, cuttings, and other foreign substances.
- .5 Protect bearings and shafts prior to delivery. Grease shafts and sheaves to prevent corrosion. Supply and install necessary extended nipples for lubrication purposes.
- .6 Ensure that existing equipment is carefully dismantled and not damaged or lost. Do not reuse existing materials and equipment unless specifically indicated.

**GENERAL MECHANICAL PROVISIONS**

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**1.7 Electrical Motors**

- .1 Supply mechanical equipment complete with electrical motors.
- .2 Provide motors designed, manufactured, and tested in accordance with the latest edition of the following codes and standards: National Electrical Manufacturer's Association (NEMA), Electrical and Electronic Manufacturer's Association of Canada (EEMAC), CSA, Canadian Electrical Code (CEC) Part 1, Institute of Electrical and Electronic Engineers (IEEE), and American National Standards Institute (ANSI). All motors to be CSA labelled. All motors to be approved for use in the designated area classification by the Provincial Electrical Protection Branch. All motors intended for use with a variable speed drive (VSD) (variance frequency drive (VFD)) shall be inverter only rated.
- .3 Unless specified otherwise, provide motors designed for full voltage starting, EEMAC Design B. Motors driving high torque or high inertia loads may be EEMAC Design C or D.
- .4 Provide motors rated for continuous duty with 1.15 service factor unless specified otherwise in the driven equipment Specifications. Provide all motors with thermal overload protection.
- .5 Motors less than ½ hp shall be 120 V, 60 Hz, 1 phase. Motors ½ hp and larger shall be 3 phase at the indicated voltage.
- .6 All motors shall be 1800 rpm indicated otherwise specified.
- .7 Provide motors with grease or oil lubricated anti-friction type ball or roller bearings.
- .8 Provide motors designed with Class B insulation; Class F insulation for totally enclosed motors.
- .9 Refer to electrical specifications, **Division 16**, for voltage, frequency, and phase data. This shall take precedence over any reference in **Division 15**.
- .10 Where motor power is stated in watts or kilowatts, nominal motor horsepower multiplied by 746 or 0.746 respectively, has been used as the conversion factor.
- .11 Minimum certified motor efficiency shall be as outlined in Manitoba Hydro's latest high efficiency motor incentives program, or the following table, whichever indicates the higher minimum efficiency.





**GENERAL MECHANICAL PROVISIONS**

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**2. PRODUCTS – NOT USED**

**3. EXECUTION – NOT USED**

**END OF SECTION**

**PETROLEUM PRODUCTS DISTRIBUTION SYSTEMS**

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**1. GENERAL**

**1.1 Scope**

- .1 This Section describes requirements for providing the fuel oil pumps, separators/filters, pressure regulators and strainers.
- .2 The Contractor shall be responsible for shipping and offloading the components, in a protected environment, to the location as designated On-Site by the City.
- .3 Provide Shop Drawings for all components.
- .4 The Contractor shall provide installation support to the Installation Contractor and performance verification.

**1.2 Submittals**

- .1 Submit Shop Drawings for pumps, separators/filters, pressure regulators and strainers in accordance with **Section 01300 – Submittals**.
- .2 All accessories data and cut sheets, and a complete installation description is to be submitted for the Operation and Maintenance (O&M) manuals in accordance with **Section 01730 – Operation and Maintenance Manuals**.

**2. PRODUCTS**

**2.1 Pumps**

- .1 General: positive displacement, heavy duty ductile iron construction, directdrive, pressure rated up to 1.75 MPa.
- .2 Capacity: 27 L/min at 1800 r/min, with TEFC motor, 0.56 kW ( $\frac{3}{4}$  hp).
- .3 Relief valve: external mounted, piped to return surplus petroleum product to supply side of pump.
- .4 Duplicate control switches: to shut down pump in event of emergency.
- .5 Pumps for transfer of liquids from bulk storage to storage tanks: control equipment to ensure that system cannot be subjected to pressures above design working pressure.

**2.2 Pressure Regulator**

- .1 Constant pressure type, ductile iron, with stainless steel trim.
- .2 Size and capacity: 50 mm (2 inch NPS). Pressure range 0 to 1450 kPa.

**PETROLEUM PRODUCTS DISTRIBUTION SYSTEMS**

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**2.3 Strainer**

- .1 Duplex style, cast iron body: to American Standards for Testing and Materials (ASTM). A 48, malleable iron exterior trim, stainless steel baskets with 0.8 mm perforations, screwed 50 mm and under or flanged ends 63 mm and over, 860 kPa American National Standards Institute (ANSI) pressure rating.

**2.4 Filter/Separators**

- .1 To remove water and solids to level of cleanliness approved by the Contract Administrator.
- .2 Sampling connections on inlet and discharge connections.

**3. EXECUTION**

**3.1 Training**

- .1 Provide demonstration and training in accordance with **Division 1**.

**END OF SECTION**

## **OUTDOOR FUEL TANKS AND ACCESSORIES**

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### **1. GENERAL**

#### **1.1 Scope**

- .1 This Section describes requirements for providing the equipment, labour and materials necessary to furnish a fuel oil storage tank systems utilizing three (3) aboveground steel tanks with 110% secondary containment provided by a steel dike.
- .2 Requirements include furnishing all equipment and accessories necessary to make complete systems for the storage and dispensing of fuel oil.
- .3 The Contractor shall be responsible for shipping and offloading the tanks, in a protected environment, to the location as designated on-site by the City.
- .4 Provide Shop Drawings for all tanks, pipe, sumps, level indicators and alarms.
- .5 The Contractor shall provide installation support to the Installation Contractor and performance verification.

#### **1.2 Standards**

- .1 The manufacture and installation of aboveground storage tank systems described in this section shall adhere to the following standards and regulatory requirements:
  - .1 Underwriter's Laboratory of Canada (ULC)
    - .1 ULC-S601-00, Standard for Shop Fabricated Steel Aboveground Horizontal Tanks for Flammable and Combustible Liquids.
    - .2 ULC-S653-94 Amendment 1, Standard for Aboveground Protected Tank Assemblies for Flammable and Combustible Liquids.
    - .3 ULC/ORD-C142.19-1994, Spill Containment Devices for Aboveground Flammable and Combustible Liquids Storage Tanks.

#### **1.3 Submittals**

- .1 Submit Shop Drawings for tanks, leak detection system, level indicators, piping, stairs, and sumps in accordance with **Section 01300 – Submittals**.
- .2 All outdoor fuel tank, piping, accessories data and cut sheets, and a complete installation description is to be submitted for the Operation and Maintenance (O&M) manuals in accordance with **Section 01730 – Operation and Maintenance Manuals**.

#### **1.4 Quality Assurance**

- .1 Shop Inspections

## **OUTDOOR FUEL TANKS AND ACCESSORIES**

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- .1 The Contractor shall provide a Contract Work Schedule including approximate dates for the start of fabrication, the completion of fabrication, inspection, testing and shipping. In addition, the Contractor shall notify the Contract Administrator five (5) working days prior to final inspection.
- .2 The Contract Administrator will inspect the completely fabricated tanks prior to shipment. The Contractor shall not ship the tank prior to the Contract Administrator's final inspection and written approval.

## **2. PRODUCTS**

### **2.1 Above Ground Double Containment Fuel Storage Tanks (Outside Building)**

- .1 Capacity:
  - .1 Actual volume: 35,072 L
  - .2 Usable volume: 33,300 L
  - .3 Length: 9,753 mm
  - .4 Width: 2,286 mm
  - .5 Height: 2,591 mm
  - .6 Weight Empty: 7,320 kg
- .2 Primary Tank:
  - .1 Conform to ULC-S601-93 specifications.
  - .2 The tank shall be provided with wear plates under the fill and gauge stick openings.
  - .3 Spill Box: The spill box shall meet the requirements of a 600 mm (24 inch) diameter manhole complete with lockable cover and stainless steel hinges. A fitting plate which attaches and seals to the bottom of the manhole throat to form a 70 L spill box. The fitting plate shall include a 100 mm (4 inch NPT) coupling for fill port attachment, a 20 mm ( $\frac{3}{4}$  inch NPT) drain back coupling that manually drains any liquid accumulated in the spillbox back into the tank and a 50 mm (2 inch NPT) coupling equipped with a dip hatch for the dip port. The fitting plate shall be removable for primary access to the tank.
  - .4 Top Discharge: 100 mm (4 inch NPT) 150 lb coupling complete with 100 mm to 40 mm (4 inch to 1 $\frac{1}{2}$  inch) reducer bushing, 40 mm (1 $\frac{1}{2}$  inch) schedule 40 drop tube.
  - .5 Vents: Normal tank vent and emergency vent.
  - .6 Spare Couplings: 100 mm (4 inch NPT) 150 lb top coupling with M.I. plug.

**OUTDOOR FUEL TANKS AND ACCESSORIES**

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- .7 Level Indicator: Two (2) 50 mm (2 inch NPT) couplings.
- .8 Water Draw-off: 50 mm (2 inch NPT) coupling with 38 mm (1½ inch) pipe to within 13 mm (½ inch) of the tank bottom.
- .3 Secondary Containment:
  - .1 Conform to ULC-653-94 specifications.
  - .2 The containment capacity is not less than 110% of the nominal capacity of the primary tank.
  - .3 Containment is designed to withstand hydrostatic testing without permanent distortion.
  - .4 The containment covers a minimum of 300° of the primary shell and 100% of the primary heads.
  - .5 The containment is protected against the entry of precipitation by seal welding the containment to the primary tank. One (1) primary cylinder head and the cylinder sidewall are in intimate contact with the containment. The 110% minimum primary capacity is gained by an interstitial space at the opposite end of the tank. The containment is constantly vented to atmosphere for normal and emergency venting to venting capacity of the primary tank. A 100 mm (4 inch NPS) inspection port is installed above the interstitial space for periodic inspections of the space.
  - .6 A grounding lug connection is located on the base pad for electrical grounding of the unit.
  - .7 Containment Inspection: 50 mm (2 inch NPT) coupling.
  - .8 Secondary containment emergency venting.
- .4 Base Support Saddle: Two (2) designed and located as per ULC requirements. Saddles are to be designed to have a maximum foundation bearing load of 120 kPa (2500 lb/ft<sup>2</sup>).
- .5 Name Plates:
  - .1 Each tank shall have two name plates, permanently mounted to the shell. One (1) shall be the “Primary Name Plate” and the other the “Secondary Name Plate”. The information to be shown on these is described below.
    - .1 The primary name plate shall contain all information required by the ULC Standard including the ULC label.
    - .2 The secondary name plate shall include the information listed below that is not contained on the primary name plate.
      - .1 Manufacturer’s name and address

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**OUTDOOR FUEL TANKS AND ACCESSORIES**

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- .2 Manufacturer's serial number
  - .3 Month and year fabricated
  - .4 Shop test – type and pressure
  - .5 Nominal capacity
  - .6 Design capacity
- .2 Nameplates are to be made of 10 gauge stainless steel and stand off the tank or jacket surface a minimum of 50 mm (2 inches).
- .6 Finish:
- .1 Exposed primary tank exterior, secondary containment exterior, base support saddle pads, access and accessories are all commercially sandblasted to SSPC-SP6 specifications and coated with two (2) coats of epoxy primer (3 mils D.F.T.). One (1) coat of high gloss white enamel top coat (3 mils D.F.T.) is applied to all exterior primed surfaces.
  - .7 Lifting Lugs: sized and located as per ULC requirements.
  - .8 Provide bottom loading fill system c/w locking fill cap, gate valve, check valve, mounting brackets, reservoir assembly and piping and bushings to standard 100 mm fitting. Use materials and appurtenances that are suitable for diesel fuel. All valves and accessories to be steel, class 150, minimum.
  - .9 Standard of acceptance: Westeel FV-350.

**2.2 Anti-Syphon Valve**

- .1 Valve to be able to prevent the flow of fuel when the pump is not operating, installed in the tank outlet.
- .2 Standard of Acceptance: EBW model 636.

**2.3 Tank Gauge System**

- .1 Provide tank gauge system capable of continuous level monitoring and leak detection for the above ground storage tanks and generator sub-base fuel tanks.
- .2 Provide continuous level monitoring utilizing magnetostrictive probes.
- .3 Provide leak detection of the interstitial space on all tanks. Sensors shall discriminate between water and hydrocarbons.
- .4 Provide leak detection of underground piping system. Sensors to be located in all transition sumps.



**OUTDOOR FUEL TANKS AND ACCESSORIES**

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- .5 Control console shall provide alarm outputs to disable fuel transfer upon leak detection.
- .6 Control console shall provide tank level and leak detector status to the generator control system utilizing digital communications
- .7 The tank gauge system shall be manufactured by OPW Fuel Management Systems.

**3. EXECUTION**

**3.1 General**

- .1 Flush and clean fuel tank prior to delivery to Site.

**3.2 Testing**

- .1 Primary tank and secondary containment are to be air pressure tested to ULC-S601-93 Sections 3.12 and 4.5 as stated and a soap solution shall be applied to all seams and fittings for visual inspection.
- .2 The test report shall be submitted to the Contract Administrator prior to the shipping of the tanks.

**3.3 Training**

- .1 Provide demonstration and training in accordance with **Division 1**.

**END OF SECTION**

## ELECTRICAL GENERAL REQUIREMENTS

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### 1. GENERAL

#### 1.1 Work Included

- .1 The design, supply, verification of the On-Site installation, testing, performance verification, and training for the 4160 VAC switch gear, standby power generators, and grounding system as outlined in **Section 16015 – Scope of Supply**.

#### 1.2 Quality Assurances

- .1 Codes, Rules, Permits, and Fees:
  - .1 Comply with all laws, ordinances, rules, regulations, codes, and orders of all authorities having jurisdiction relating to this Work.
  - .2 Comply with all rules of local Electrical Code and the applicable building codes.
  - .3 Quality of Work specified shall not be reduced by the foregoing requirements.
  - .4 All components shall be Canadian Standards Association (CSA) approved.
- .2 Standard of Workmanship:
  - .1 Execute all Work in a competent manner and to present an acceptable appearance when completed.

#### 1.3 Submittals

- .1 Submit samples as required where specified in **Division 16 and 17**.
- .2 Refer to **Section 01300 - Submittals** for general requirements for submittals.
- .3 Indicate materials, methods of construction and attachment of support wiring, diagrams, connections, recommended installation details, explanatory notes and other information necessary for completion of Work. Where equipment is connected to other equipment, indicate that such items have been coordinated, regardless of the Section under which the adjacent items will be supplied and installed.

Adjustments made on Shop Drawings by the Contract Administrator are not intended to change the Contract Price. If adjustments affect the value of the Work state such in writing to the Contract Administrator prior to proceeding with the Work.

- .4 Manufacture of Products shall conform to revised Shop Drawings.

#### 1.4 Operation and Maintenance Manuals

- .1 Refer to **Section 01730 – Operation and Maintenance Manuals** for general requirements for Operation and Maintenance (O&M) Manuals.

## **ELECTRICAL GENERAL REQUIREMENTS**

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### **1.5 Product Handling**

- .1 Use all means necessary to protect the Products of this Division until **Form 100** is completed.
- .2 Immediately make good any damage by repair or replacement at no additional cost to the City and to the approval of the Contract Administrator.
- .3 Remove advertising labels from all electrical equipment. Do not remove identification or certification labels.

## **2. PRODUCTS**

### **2.1 Selected Products**

- .1 Products and materials provided shall be new and free from all defects. Defective products or materials will be rejected regardless of previous inspections. The Contractor shall be responsible to remove and replace defective products at their expense, and shall be responsible for any resulting delays and associated expenses, which result from defective products being rejected. Related materials shall be of the same Manufacturer.

### **2.2 Quality of Products**

- .1 All products provided shall be Underwriters Laboratories of Canada (ULC) or CSA approved, or approved by local authority having jurisdiction in the area where the equipment is going to be installed.
- .2 If products specified are not approved as specified above, obtain special approval from the local regulatory authority. Pay all applicable charges levied and make all modifications required for approval.
- .3 Products provided, if not specified, shall be new, of a quality best suited to the purpose required and their use subject to approval by the Contract Administrator.

### **2.3 Uniformity of Manufacture**

- .1 Unless otherwise specifically called for in the Specifications, maintain uniformity of manufacture for similar products throughout the Work.

## **3. EXECUTION**

### **3.1 Equipment Identification**

- .1 3 mm thick plastic lamacoid name plates, white background, mechanically attached with self tapping screws, 6 mm high black lettering, to be attached to the front face of the following equipment:

**ELECTRICAL GENERAL REQUIREMENTS**

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- .1 Distribution Centres (Indicate designation, bus capacity, voltage)
- .2 Starters, contactors, and disconnects (Indicate designation, voltage, load controlled).
- .3 Control cabinet, terminal cabinets and pull boxes (system, voltage).

**END OF SECTION**

## SCOPE OF SUPPLY

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### 1. GENERAL

- .1 Refer to **Sections 16010 – General Requirements** through **16635 – Battery Chargers**.
- .2 This Section describes the Electrical Division scope of supply for the Standby Generator and 4160 VAC Switchgear Equipment electrical package.
- .3 The Contractor shall furnish all necessary components to provide a complete and fully functioning Standby Generator and 4160 VAC Switchgear Equipment electrical package.
- .4 The Contractor shall provide detail requirements for the grounding system for the 4160 VAC system, including transformers and generators, main electrical and generator building, Deacon Booster Pump building, and four (4) 600 V transformers and distribution rooms. The design shall incorporate the transformer ground grid around the service transformers, which is designed by others.
- .5 Contractor shall conduct a coordination/protective study and short circuit study for the complete electrical distribution system and submit for review.

### 1.2 Equipment Area Environment

- .1 This paragraph describes area environment for the standby generator and 4160 VAC switchgear
  - .1 The standby generator and 4160 VAC switchgear will be installed indoors in an ordinary location.
  - .2 Fuel storage tanks will be located outside.

### 1.3 Scope of Supply

- .1 5 kV primary switchgear:
  - .1 Complete metal clad switch gear including breakers, protective relays, metering, four (4) spare cubicles.
- .2 5 kV generator switchgear:
  - .1 Complete metal clad switch gear for two (2) or three (3) generators including breakers, protective relays, metering.
- .3 Generator:
  - .1 Two (2) or three (3) 1800 RPM, diesel engine, total capacity of 6.0 MW minimum.
  - .2 Fuel system including sub-base fuel tanks, two (2) double wall storage tanks, valves, transfer system, and tank gauge system.

**SCOPE OF SUPPLY**

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- .3 Neutral grounding resistor(s) and monitor(s).
- .4 Equipment/Personnel protection – protective relays to:
  - .1 Protect personnel
  - .2 Protect equipment (including transient/lightning protection)
  - .3 Synchronize generators with each other
  - .4 Synchronize generators with utility (coordinate with Manitoba Hydro and comply with their requirements)
- .5 Grounding system:
  - .1 Service transformers (two (2) units) will be resistance grounded limiting the fault to 200 Amps. Grounding resistor by others.
  - .2 Neutral grounding resistor(s) and monitor(s) for generator. Breakers and protective relaying if required for operation.
  - .3 Design of grounding system for 5 kV electrical/generator building, generators, and interconnection to 600 V system. Coordination with Manitoba Hydro is required.
  - .4 Submit design, complete with fault level calculations for review.
- .6 Control system:
  - .1 Monitor and control the operation of the 5 kV distribution/generation system including but not limited to:
    - .1 Synchronizing with utility and between generators.
    - .2 Load shedding during generator/power fail operation.
    - .3 Equipment failure/reduced capacity operation.
- .7 Coordination study:
  - .1 Complete coordination study to include the utility, 5 kV distribution and 600 V distribution. All new and existing equipment shall be included in the study
- .8 Installation of the supplied equipment will be done by others. The Contractor shall provide installation assistance, and performance verification.

**SCOPE OF SUPPLY**

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**2. PRODUCTS - NOT USED**

**3. EXECUTION - NOT USED**

**END OF SECTION**

**SWITCHGEAR ASSEMBLY TO 5 KV**

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**1. GENERAL**

**1.1 Reference Standards**

- .1 Canadian Standards Association (CAN/CSA)-C22.2 No. 31, Switchgear Assemblies.
- .2 CAN/CSA-G40.21, Structural Quality Steels.
- .3 Electrical and Electronic Manufacturer's Association of Canada (EEMAC) G1-1, Indoor and Outdoor Switch and Bus Insulators.
- .4 EEMAC G8-3.2, Metal-Clad and Station-Type Cubicle Switchgear.
- .5 American National Standards Institute/Institute of Electrical and Electronic Engineers (ANSI/IEEE) C37.20.7-19XX, Guide for testing metal-enclosed switchgear for internal arcing faults
- .6 EEMAC G14-1, Procedure for Testing the Resistance of Metal-Clad Switchgear under Conditions of Arcing Due to an Internal Fault

**1.2 Description of System**

- .1 Provide freestanding, self-supporting, pre-engineered indoor metal-clad power switchgear, shop fabricated, shipped to Site, complete with all fittings
- .2 Primary switchgear assemblies to include:
  - .1 Enclosure.
  - .2 Circuit Breakers.
  - .3 Isolating switches.
  - .4 Bus bar.
  - .5 Customer metering compartment.
  - .6 Instrument transformers.
  - .7 Control wiring and accessory devices.
  - .8 Breaker transportation dolly.
  - .9 Maintenance grounding buggy for breaker position.
  - .10 Separate, free standing, 125 VDC Power Supply c/w lead acid batteries and charging system.



## SWITCHGEAR ASSEMBLY TO 5 KV

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### 1.3 Source Quality Control

- .1 Provide Manufacturer's type test certificates indicating switchgear cubicles and components tested as integrated assembly.
- .2 The Contract Administrator will witness standard factory testing of complete switchgear assembly, including operation of switches, circuit breakers, and controls.
- .3 Notify the Contract Administrator in writing, seven (7) days prior to testing, that equipment is ready for inspection.
- .4 Submit test procedures to the Contract Administrator, at least fourteen (14) days prior to testing.
- .5 Submit six (6) copies of production test results to the Contract Administrator before equipment is shipped from factory.

### 1.4 Shop Drawings

- .1 Submit Shop Drawings in accordance with **Section 01300 – Submittals**.
- .2 Indicate:
  - .1 Floor anchoring method and dimensioned foundation Drawings.
  - .2 Dimensioned cable entry and exit locations.
  - .3 Dimensioned cable termination height.
  - .4 Dimensioned position and size of bus bars and details of provision for extension.
  - .5 Dimensioned positions of main connections, including air clearances, and support insulators.
  - .6 Layout of internal and front panel components suitably identified.
  - .7 Time current characteristics curves of protection devices.
  - .8 Dimensioned position and connection details of the arc-chamber and arc-duct.
  - .9 Metering and interlock control wiring diagrams.
  - .10 Batter charger and DC control.

### 1.5 Maintenance Data

- .1 Provide maintenance data for primary switchgear assembly for incorporation into operation and maintenance (O&M) specified in **Section 01730 - Operation and Maintenance Manuals**.

**SWITCHGEAR ASSEMBLY TO 5 KV**

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**1.6 Maintenance Materials**

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

**1.7 Delivery and Storage**

- .1 Ship switchgear assembly in upright position.
- .2 Ship channel base sills, anchoring devices in advance of switchgear.

**1.8 Protection Coordination**

- .1 Conduct coordination study. Include utility supply and 600 V distribution On-Site.
- .2 Coordinate time-current characteristics of protective relays.

**1.9 Requirements of Supply Authority Interconnection**

- .1 Submit Shop Drawings to Manitoba Hydro and obtain certification that equipment meets their requirements, before submission of Drawings to the Contract Administrator.
- .2 Provide all protective relays to meet the supply Manitoba Hydro's requirements for synchronization with the utility supply.

**2. PRODUCTS**

**2.1 Materials**

- .1 Switchgear assembly: To CAN/CSA C22.2 No.31, EEMAC G8-3.2, EEMAC G14-1, ANSI C37.20.7.
- .2 Steel for cubicles: To CAN/CSA G40.21.
- .3 Insulators: To EEMAC G1-1.

**2.2 Primary Switchgear, SWGR-E100A and SWGR-E100B**

- .1 Primary switchgear: Indoor 5 kV, 3000 A, 3 phase, 4 wire, resistance grounded at the transformer, short circuit capacity 350 MVA, BIL 60 kV. The neutral bus shall be provided regardless of the system grounding determined by **Section 16450 – Grounding Secondary**.
- .2 The switchgear enclosure arc-short circuit rating shall be 50 kA rms sym (135 kA peak), and rated arc-short circuit duration shall be 0.5 second, tested in accordance with EEMAC G14-1 and ANSI/IEEE C37.20.7.
- .3 Provide a total of four (4) spare cubicles, two (2) on each end of the bus.

**SWITCHGEAR ASSEMBLY TO 5 KV**

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**2.3 Generator Switchgear, SWGR-E200A and SWGR-E200B**

- .1 Generator switchgear: Indoor 5 kV, 3000 A, 3 phase, 4 wire, resistance grounded neutral bus, short circuit capacity 350 MVA, BIL 60 kV. The neutral bus shall be provided regardless of the system grounding determined by **Section 16450 – Grounding Secondary**.
- .2 The switchgear enclosure arc-short circuit rating shall be 50 kA rms sym (135 kA peak), and rated arc-short circuit duration shall be 0.5 second, tested in accordance with EEMAC G14-1 and ANSI/IEEE C37.20.7.

**2.4 Enclosure**

- .1 Single-high indoor arc-resistant type B or C.
- .2 The switchgear assembly shall consist of individual vertical sections housing various combinations of circuit breakers and auxiliaries, bolted to form a rigid metal-clad switchgear assembly. Metal side sheets shall provide grounded barriers between adjacent structures and solid removable metal barriers shall isolate the major primary sections of each circuit. Two (2) rear covers shall be furnished for each vertical section for circuit isolation and ease of handling. Hinged rear doors, complete with provisions for padlocking, shall be provided. The switchgear shall be arranged in 1-high configuration.
- .3 An enclosed arc-chamber with arc duct exit shall be furnished for installation above the switchgear. Arc-duct exit location shall be determined at the time of Shop Drawing submission. Arc exhaust shall be vented from the arc-chamber to the exit location via arc-duct. Arc duct pieces as required to vent the arc exhaust from the arc-chamber to the exit location shall be provided.
- .4 The stationary primary contacts shall be silver-plated and recessed within insulating tubes. A steel shutter shall automatically cover the stationary primary disconnecting contacts when the breaker is in the disconnected position or out of the cell. Provide rails to allow withdrawal of each circuit breaker for inspection and maintenance without the use of a separate lifting device.
- .5 Use non-corrosive bolts and hardware.
- .6 100 mm steel channel sills for base mounting in single length common to multi-cubicle switchboard.
- .7 Provision for future extension on both sides of cubicle unit.
- .8 Provide 100 mm infrared sightglass, suitable for both short and long wave infrared, in front of each breaker and interrupt switch.

## **SWITCHGEAR ASSEMBLY TO 5 KV**

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### **2.5 Bus Bars**

- .1 3 phase and full capacity neutral insulated bus bars, continuous current rating of 3000 A at 5 kV, extending full width of multi-cubicle switchboard suitably supported on insulators.
- .2 Bus bar insulation shall be epoxy flame-retardant and track-resistant. Bus supports shall be flame-retardant and track-resistant glass polyester.
- .3 Main connections between bus bars, major switching components of continuous current rating to match major switching components.
- .4 High conductivity copper for bus bars and main connections.
- .5 Provision for extension of bus on both sides of unit without need for further drilling or field preparation.
- .6 Brace bus bar system including ground bus to withstand stresses resulting from short circuit currents specified.
- .7 Tin surfaced joints, secured with non-corrosive bolts and washers, tightened with torque wrench in accordance with Manufacturer's recommendations.
- .8 Identify phases of bus bars by suitable marking.
- .9 Provide bus bar connectors when switchgear shipped in more than one (1) section.

### **2.6 Grounding**

- .1 Copper ground bus not smaller than 50 x 6 mm extending full width of multi-cubicle switchboard and situated at bottom.
- .2 Lugs at each end for size #2/0 to #4/0 AWG grounding cable.
- .3 Bond non-current carrying parts, including switchgear framework, enclosure and bases to ground bus.

### **2.7 Circuit Breaker**

- .1 Provide draw out Vacuum breakers to **Section 16350 – Medium Breakers Circuit Breakers**.
- .2 One (1) breaker per section.

### **2.8 Interlocks**

- .1 Provide interlocks between breakers and other equipment to as described in another Section.

**SWITCHGEAR ASSEMBLY TO 5 KV**

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**2.9 Primary Instruments**

- .1 Provide Digital Circuit monitor meters for each breaker to **Section 16431 – Metering and Switchboard Instruments.**

**2.10 Instrument Transformers**

- .1 Provide Instrument transformers to **Section 16432 – Instrument Transformer.**

**2.11 Customer Metering**

- .1 Mounting and wiring for following:
  - .1 Potential transformers draw out.
  - .2 Current transformers.
- .2 Separate compartment and metal raceway for exclusive use of customer metering.
- .3 Digital metering in accordance with **Section 16431 – Metering and Switchboard Instruments.**

**2.12 Spare Fuses**

- .1 Provide three (3) spare potential transformer fuses in suitable container stored in enclosure.

**2.13 Miscellaneous Hardware**

- .1 Provide miscellaneous hardware as required, compatible with other components. Provide warning signs as required by Electric Utility and Inspection Authorities.
- .2 Provide DC Power supply batteries and charger, free standing in a painted steel cabinet. Power supply shall be sized to feed control power to the 5 kV switchgear breakers and protection and control equipment.
  - .1 Size batteries to provide sufficient power to operate all breakers connected to it through two (2) complete cycles including spring recharging, and last forty eight (48) hours minimum in monitoring standby mode.
  - .2 Use lead acid type batteries with ten (10) year life.
  - .3 Power supply to have an electronic monitoring unit with LED indicator lights and dry master alarm contact to be connected to and monitored by, the Electrical Monitoring system.
  - .4 Unit to have DC output breakers for each switchboard controlled.
  - .5 Input power 208 V, 3 phase.

**SWITCHGEAR ASSEMBLY TO 5 KV**

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- .3 Provide breaker lifting device and truck for moving and servicing the breaker.
- .4 Provide external breaker test station for testing breaker operation.

**2.14 Finishes**

- .1 Cubicle exteriors: Gray.
- .2 Cubicle interiors: White.
- .3 Supply two (2) spray cans touch up paint.

**2.15 Equipment Identification**

- .1 Provide equipment identification in accordance with **Section 16010 - Electrical General Requirements**.
- .2 Nameplates:
  - .1 Switchgear designation:
  - .2 Individual cubicle designations:

**2.16 Warning Signs**

- .1 Provide warning signs for Neutral Grounding Resistor and ARC Flash Hazard in accordance with **Section 16010 - Electrical General Requirements**.

**2.17 Acceptable Manufacturers**

- .1 Square D Masterclad Switchgear with VR Vacuum Circuit Breakers.
- .2 Cutler-Hammer VacClad–W Switchgear with VCP-W Vacuum Circuit breakers.

**3. EXECUTION**

**3.1 Installation**

- .1 Installation by others.
- .2 Provide installation assistance in accordance with **Section 01650 – Equipment Installation**.

**3.2 Field Quality Control**

- .1 Perform tests in accordance with **Division 1**.

**SWITCHGEAR ASSEMBLY TO 5 KV**

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- .2 Tests shall be performed by the Manufacturer's Representative of the switchgear or a suitably qualified person and a written report shall be submitted. Consider the following as a guide, adjusted to suit actual equipment requirements:
  - .1 Clean, vacuum and inspect interiors of all cubicles.
  - .2 Clean and check main bus contacts.
  - .3 Check interlocks for proper operation and safety procedure.
  - .4 Inspect for proper grounding.
  - .5 Inspect bus and support insulators, clean, and polish porcelain.
  - .6 Check and tighten all hardware and connections.
  - .7 Lubricate according to Manufacturer's instructions.
  - .8 Megger and hi-pot test phase to phase and phase to ground using a minimum of 5000 VDC. If values not satisfactory, perform the required remedial Work and repeat tests until readings are acceptable to the Contract Administrator.
  - .9 Check phase rotation of each feeder and verify across tiebreaker.
  - .10 Operate circuit breaker closing and tripping mechanisms, to verify correct functioning.
  - .11 Place primary switchgear in service and check digital meter readings to ensure proper functioning of instruments and satisfactory phase balance and power factor of load.
  - .12 Perform step and touch potential and station ground tests to comply with Canadian Electrical Code (CEC) requirements.
- .3 Energization
  - .1 Assist Manitoba Hydro to perform energize the two 66 kV transformers.
  - .2 Energizing distribution transformers:

Before energizing the distribution transformers, the following prerequisites shall be met:

    - .1 The DC batteries of the switchgear shall be fully charged, and DC power to 4.16 kV breaker control circuits and protective relaying circuits shall be normal.
    - .2 The springs of the 4.16 kV breakers shall be charged.

**SWITCHGEAR ASSEMBLY TO 5 KV**

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- .3 The trip circuits of the 4.16 kV breakers shall be complete.
- .4 All the protective relays shall be reset.
- .5 The 4.16 kV breakers shall be in open positions; breaker trucks shall be in connected positions.
- .6 The 4.16 kV PTs shall be in place.

**3.3 Training**

- .1 Provide demonstration and training in accordance with **Division 1**.

**END OF SECTION**



## MEDIUM VOLTAGE CIRCUIT BREAKERS

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### 1. GENERAL

#### 1.1 Reference Standards

- .1 Manitoba Hydro, Interconnection Guideline, DRG2003.

#### 1.2 Product Data

- .1 Submit Product data in accordance with **Section 01300 – Submittals**.

#### 1.3 System Description

- .1 All MV breakers shall be monitored by the standby generator control system as to breaker position, status, and spring charge status.
- .2 The primary switchgear 5 kV main and tie breakers, the generator switchgear breakers, and the generator neutral grounding resistor breaker shall be controlled automatically by the standby generator control panel and are part of the transfer scheme for standby power as well as peak shaving.
- .3 It is planned to use the plant load to exercise the standby generators and for peak load shaving. Closed transition switching must be allowed between 5 kV main and tie MV breakers to allow this to happen seamlessly to the plant operation.
- .4 Program relays settings for all relays supplied and twenty one (21) additional relays according to the coordination study performed in **Section 16405 – Coordination and Short Circuit Study**.
- .5 Program relay logic for all relays supplied and twenty one (21) additional relays to provide zone interlocking and load shedding scheme.
- .6 Provide the EnerVista software suite with licensing for five (5) concurrent users and all relays supplied plus twenty one (21) additional relays.
- .7 Provide one (1) spare relay hardware module of each type.
- .8 Provide one (1) complete spare relay rack with all hardware modules required less the Central Processing Unit (CPU).

### 2. PRODUCTS

#### 2.1 Circuit Breakers - 5 kV

- .1 Design 2: Indoor vacuum circuit breaker, 3 or 4 pole, single break, power operated, draw out breaker element, sized as specified. The number of poles shall be determined by the system grounding specified in **Section 16450 – Grounding Secondary**.

**MEDIUM VOLTAGE CIRCUIT BREAKERS**

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- .2 Breaker operating mechanism:
  - .1 125 VDC solenoid closing and 125 VDC shunt trip.
  - .2 Stored energy closing.
  - .3 Motorized charging mechanism
- .3 Breaker interrupting capacity: 350 MVA at 5 kV.
- .4 Auxiliary contacts: 2-N.O., 2-N.C.
- .5 Auxiliaries:
  - .1 Status light: open-green, close-red.
  - .2 Status flags: open-green, close-red.

**2.2 Protective Relay – Mains**

- .1 Solid state, capable of zone selective interlocking, conforms to supply authority's requirements for peak shaving operation.
- .2 Multiple setting groups for variable configurations (generators running, tie CB closed, transformer cooling fans on, etc).
- .3 Suitable for resistance grounded neutral.
- .4 Modbus TCP/IP communications to the Standby Generator control system utilizing a 10BaseF connection.
- .5 Embedded IEC 61850 protocol for inter-relay communications.
- .6 19 inch rack mount.
- .7 Circuit breaker control, status and condition monitoring
- .8 Minimum protection functions:
  - .1 Three (3) instantaneous overcurrent trip.
  - .2 Reverse power trip
  - .3 Overvoltage trip.
  - .4 Undervoltage trip.
  - .5 Frequency trip.
  - .6 Time overcurrent trip.

**MEDIUM VOLTAGE CIRCUIT BREAKERS**

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- .7 Locking-out relay.
  - .8 Time-delay relay.
  - .9 Ground fault trip. Suitable for use with neutral grounding resistor.
  - .10 Negative sequence trip.
  - .11 Synchronism check
  - .12 Differential (Percentage)
- .9 Approved product: Multilin T60, or approved equal.

**2.3 Protective Relay – Feeders**

- .1 Solid state, capable of zone selective interlocking.
- .2 Multiple setting groups for variable configurations (generators running, tie CB closed, cooling fans on, etc).
- .3 Suitable for resistance grounded neutral.
- .4 Modbus TCP/IP communications to the Standby Generator control system utilizing a 10BaseF connection.
- .5 Embedded IEC 61850 protocol for inter-relay communications.
- .6 19 inch rack mount.
- .7 Circuit breaker control, status and condition monitoring
- .8 Minimum protection functions:
  - .1 Three (3) instantaneous overcurrent trip.
  - .2 Overvoltage trip.
  - .3 Undervoltage trip.
  - .4 Frequency trip.
  - .5 Time overcurrent trip.
  - .6 Locking-out relay.
  - .7 Time-delay relay.
  - .8 Ground fault trip. Suitable for use with neutral grounding resistor.

**MEDIUM VOLTAGE CIRCUIT BREAKERS**

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.9 Negative sequence trip.

.9 Approved product: Multilin F60, or approved equal.

**2.4 Protective Relay – Generators**

.1 Solid state, capable of zone selective interlocking.

.2 Multiple setting groups for variable configurations (generators running, tie CB closed, cooling fans on, etc).

.3 Suitable for resistance grounded neutral.

.4 Modbus TCP/IP communications to the Standby Generator control system utilizing a 10BaseF connection.

.5 Embedded IEC 61850 protocol for inter-relay communications.

.6 19 inch rack mount.

.7 Circuit breaker control, status and condition monitoring.

.8 Minimum protection functions:

.1 Three instantaneous overcurrent trip.

.2 Overvoltage trip.

.3 Undervoltage trip.

.4 Frequency trip.

.5 Time overcurrent trip.

.6 Locking-out relay.

.7 Time-delay relay.

.8 Ground fault trip. Suitable for use with neutral grounding resistor.

.9 Negative sequence trip.

.10 Loss of excitation.

.11 Synchronism check.

.12 Differential (Percentage)

.9 Approved product: Multilin G60, or approved equal.

## **MEDIUM VOLTAGE CIRCUIT BREAKERS**

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### **3. EXECUTION**

#### **3.1 Installation**

- .1 Installation by others.
- .2 Provide installation assistance in accordance with **Section 01650 – Equipment Installation**.

#### **3.2 Breaker Tripping Characteristics**

- .1 The protective relay installed in BK-E100A switchgear provides the primary protection of 4.16 kV bus SWGR-E100A and backup protection for 4.16 kV transformers:
  - .1 3 phase instantaneous overcurrent (50) interlocked by the blocking signals initiated by the 50 protection in BK-E100C.
  - .2 3 phase inverse-time overcurrent (51) coordinated with downstream 51 protection installed in 4.16 kV feeder breakers, interlocked by the blocking signal initiated by the 51 protection in BK-E100B. Multiple setting groups depending on status of BK-E100B and BK-E100C.
  - .3 Residual ground fault instantaneous overcurrent (50G) interlocked by any of the blocking signals initiated by the 50G protection from BK-E100C breaker.
  - .4 Residual ground fault inverse-time overcurrent (51G) coordinated with downstream 51G on 4.16 kV feeder breakers.
  - .5 Reverse power protection (32) when sensing the power supply from substation feed back to utility.
  - .6 Any above functions shall trip the breaker BK-09A-100A.
- .2 The protective relay installed in BK-E100B switchgear provides the primary protection of 4.16 kV bus SWGR-E100B and backup protection for 4.16 kV transformers:
  - .1 3 phase instantaneous overcurrent (50) interlocked by the blocking signals initiated by the 50 protection in BK-E100C.
  - .2 3 phase inverse-time overcurrent (51) coordinated with downstream 51 protection installed in 4.16 kV feeder breakers, interlocked by the blocking signal initiated by the 51 protection in BK-E100A. Multiple setting groups depending on status of BK-E100A and BK-E100C.
  - .3 Residual ground fault instantaneous overcurrent (50G) interlocked by any of the blocking signals initiated by the 50G protection from BK-E100C breaker.
  - .4 Residual ground fault inverse-time overcurrent (51G) coordinated with downstream 51G on 4.16 kV feeder breakers.

**MEDIUM VOLTAGE CIRCUIT BREAKERS**

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- .5 Reverse power protection (32) when sensing the power supply from substation feed back to utility.
- .6 Any above functions shall trip the breaker BK-09A-100B.
- .3 The protective relay installed in BK-E100C switchgear provides the secondary protection of 4.16 kV buses SWGR-E100A and SWGR-E100B:
  - .1 3 phase instantaneous overcurrent (50) protection, initiating a blocking signal to 50 protection in BK-E100A and BK-E100B.
  - .2 Residual ground fault instantaneous overcurrent (50G) protection, initiating a blocking signal to 50G protection in BK-E100A and BK-E100B.
  - .3 Any above functions shall trip the breaker BK-E100C.
- .4 The protective relay installed in each 4.16 kV feeder breaker switchgear to clear fault on that feeder (BK-E101A to BK-E106A and BK-E101B to BK-E106B):
  - .1 3 phase instantaneous overcurrent (50) initiating blocking signals to 50 protections of main breakers.
  - .2 3 phase inverse-time overcurrent (51) coordination with upstream and downstream 51 protections.
  - .3 Residual ground fault instantaneous overcurrent (50G) initiating blocking signals to 50G protections of the main breakers.
  - .4 Residual ground fault inverse-time overcurrent (51G) initiating blocking signals to 50G protections of the main breakers.
  - .5 Any above function shall trip the feeder breaker.
- .5 The generator protective relay provides generator protection:
  - .1 Current differential protection (87).
  - .2 Reverse power protection (32).
  - .3 Phase-balance or reverse-phase current protection (46).
  - .4 Out of step protection (78).
  - .5 Undervoltage & Overvoltage protection (27 & 59).
  - .6 Frequency protection (81).
  - .7 Excitation fault protection (40).

**MEDIUM VOLTAGE CIRCUIT BREAKERS**

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- .8 Phase & grounding overcurrent protection (51 & 51G).
- .9 100% stator grounding protection (64G).
- .10 Thermal protection (49).
- .11 Any above functions shall trip the generator breaker (BK-E201A or BK-E201B) and field breaker.

**3.3 Training**

- .1 Provide demonstration and training in accordance with **Division 1**.

**END OF SECTION**

## COORDINATION AND SHORT CIRCUIT STUDY

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### 1. GENERAL

#### 1.1 Description

- .1 Provide a coordination/protective study, short circuit study and ARC Flash study of all equipment specified herein and submit to the Contract Administrator as specified in D15.
- .2 The Contractor shall conduct the short circuit study to determine the maximum size in kVA and minimum impedance of the two (2) service transformers. The two (2) service transformers can be connected in parallel for a short period of time during switching between two (2) incoming utility feeders.
- .3 The short circuit study shall provide maximum fault levels with no generation, one (1) generator, two (2) generators and three (3) generators in combination with four (4) 66/4.16 kV transformer sizes.
- .4 Utilizing the short circuit study provided by the Contractor the Contract Administrator will select the final size and impedance of the service transformers to limit the fault level to 350 MVA.
- .5 The ARC Flash and coordination/protective studies shall be provided once the selection of 66/4.16 kV service transformers has been finalized.
- .6 Include the following:
  - .1 5 kV cable thermal damage curves
  - .2 5 kV Vacuum Circuit Breaker , overcurrent, overload and ground fault devices.
  - .3 600 V air circuit breaker overcurrent, overload, and ground fault devices.
  - .4 347/600 and 120/208 V panelboards, motor control centres (MCCs), and switchgear, connecting feeder cables and bus duct.
  - .5 66/5 kV and 4160/600 V transformer damage curves, magnetizing currents for all transformers 150 kVA and larger.
  - .6 Locked rotor currents, acceleration times and damage curves for motors 75 kW and larger.
  - .7 Generator overcurrent device, switchboard and generator short circuit curves.
  - .8 Any additional data necessary for successful completion of the coordination and short circuit study.
- .7 Data shall clearly state the operating time in cycles of each breaker and indicate whether the time current curves for relays are inclusive of breaker trippings time or otherwise.



## **COORDINATION AND SHORT CIRCUIT STUDY**

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- .8 Prepare a summation chart showing all ratings and settings with easy reference to the appropriate curve.
- .9 Submit symmetrical and asymmetrical fault current calculations to verify the correct choice of the protective elements of the system.
- .10 Prepare a systems single line diagram on which the resultant short circuit values, device numbers and equipment ratings are shown.
- .11 Include a list of recommended settings for each relay.
- .12 Provide recommendations for the class CTs on the primary and secondary side of all 4160/600 V transformers to prevent saturation under fault conditions.

### **1.2 Qualifications**

- .1 This study shall be performed by and bear the stamp of a Professional Engineer registered in the Province of Manitoba.

### **1.3 Submittals**

- .1 In accordance with **Section 01300 - Submittals**, submit the short circuit study for review prior to carrying out the coordination/protective study.
- .2 Submit typed results of coordination and short circuit study in maintenance manuals, in accordance with **Section 01730 - Operation and Maintenance Manuals**.

## **2. PRODUCTS**

### **2.1 Tripping Devices**

- .1 Relay style, CT class, CT ratios and fuse sizes have been selected on a preliminary basis for design purposes. Base final selection on the results of this study and include at no extra cost.

**END OF SECTION**

**METERING AND SWITCHBOARD INSTRUMENTS**

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**1. GENERAL**

**1.1 Description**

- .1 Digital Power Instrumentation Package - Full-Featured.
  - .1 Provide Digital AC Instrumentation Package including switchboard instruments.
  - .2 The Digital Power Instrumentation Package to be ION 7550 power meters complete with Ethernet communications, manufactured by Power Measurement Ltd.
  - .3 Central Computer server and energy management software.

**1.2 Reference Standards**

- .1 Conform to the following standards:
  - .1 American National Standards Institute/Institute of Electrical and Electronic Engineers (ANSI/IEEE) C37.90A surge withstand and fast transient tests.
  - .2 FCC Part 15 Subpart J for Class A computing devices.
  - .3 National Electrical Manufacturer's Association (NEMA) 250 standards factory finishes.

**1.3 Submittals for Review**

- .1 Submit Shop Drawings in accordance with **Section 01300 – Submittals**.
- .2 Indicate meter, instrument outline dimensions, panel drilling dimensions and include cutout template.
- .3 Provide wiring details for monitoring equipment.

**1.4 Closeout Submittals**

- .1 Provide instrument installation and operation manual(s) and troubleshooting guide(s). Provide serial communications protocol document(s). Refer to **Section 01730 – Operation and Maintenance Manuals**.

**2. PRODUCTS**

**2.1 Digital Power Instrumentation Package - Full-Featured**

- .1 Provide and install the Digital AC Instrumentation Package capable of measuring, calculating and directly displaying on the front panel display the following information:
  - .1 Volts on each phase plus average of all 3 phase.

**METERING AND SWITCHBOARD INSTRUMENTS**

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- .2 Current on each phase plus average of all 3 phase.
  - .3 Neutral or ground current.
  - .4 Frequency.
  - .5 Power factor.
  - .6 kVA.
  - .7 kVAR.
  - .8 kW.
  - .9 Total kWh as an accumulating total, providing bi-directional (import/export) indication.
  - .10 Total kVARH as an accumulating total, providing bi-directional (import/export) indication.
  - .11 kW Demand, user-programmable length of each demand period and the number of periods averaged to match local utility billing method.
  - .12 Amps Demand.
  - .13 kVA Demand, user-programmable length of each demand period and the number of periods averaged to match local utility billing method.
  - .14 Total harmonic current and voltage.
  - .15 Individual harmonic true rms current and voltage to the 63rd harmonic
- .2 Each power meter to have:
- .1 True RMS measurement.
  - .2 Direct connection to 600 V, 3 phase, 4 wire system.
  - .3 Fourth current input for measurement of ground or neutral current.
  - .4 Eight (8) digital inputs for status/counter inputs, self excited dry contact sensing, to remotely monitor breaker status, ground fault relay status, or any other dry contact input.
  - .5 Storage in non-volatile memory for the following:
    - .1 A time-stamped alarm and event log of up to 800 events which records event date, time (to 0.001 sec), event type, and value for all over/under limit conditions, all status input activity, and all relay operations.

**METERING AND SWITCHBOARD INSTRUMENTS**

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- .2 A time-stamped minimum/maximum log, which records the value of any parameter exceeding the previous highest or lowest value recorded. Log to be read from the front panel display or via the communications port.
- .3 All setup data.
- .6 Waveform capture capability allowing any of the eight (8) voltage and current input channels to be digitally sampled at 256 samples/60 Hz cycle. Waveform capture to be initiated using commands made via the communications port or event triggered. Waveform capture data is to be made accessible via the communications port.
- .7 Liquid crystal display, 320 x 240 pixels resolution, backlight.
- .8 Serial communications ports:
  - .1 One (1) RS-232C/RS-485, and one (1) RS-485
  - .2 Protocols: ION, Modbus RTU
  - .3 Baud rate: RS-232, 300 bps to 115,200 bps.
  - .4 Baud rate: RS-485, 300 bps to 57,600 bps.
- .9 Ethernet port:
  - .1 Protocols: ION, Modbus TCP.
  - .2 10Base-FL:
  - .3 Simultaneous communications using ION and Modbus TCP protocols.
- .10 Field programmability as follows:
  - .1 Volts scale, volts mode (wye, delta, single phase), amps scale, Vaux scale, baud rate, TCP/IP address and the relay operation are programmable from the front panel.
  - .2 All parameters in 10.1 above, plus additional alarm/event parameters may be programmed via the communications port using a portable terminal or a computer.
  - .3 Ensure programming is password protected.
- .11 Compliance with the following standards:
  - .1 Underwriters Laboratories of Canada (ULC) certified.
  - .2 Canadian Standards Association (CSA) approved.

**METERING AND SWITCHBOARD INSTRUMENTS**

- .3 Voltage, current, status, relay and power inputs pass the ANSI/IEEE C37.90A surge withstand and fast transient tests.
- .4 Certified to comply with FCC Part 15 Subpart J for Class A computing devices.
- .12 300 amps for one (1) second surge protection on all four (4) current inputs.
- .13 The following accuracy, resolution, range, and power supply ratings specifications:

| <b>Parameter</b>     | <b>Accuracy</b> | <b>Resolution</b>   | <b>Range</b>               |
|----------------------|-----------------|---------------------|----------------------------|
| Volts (V1, V2, V3)   | 0.1%            | 0.1%                | 0 - 1,000,000 <sup>1</sup> |
| Amps (I1, I2, I3)    | 0.1%            | 0.1%                | 0 - 30,000                 |
| Neutral Current (I4) | 0.4%            | 0.1%                | 0 - 9,999                  |
| kW                   | class 0.2       | 0.1%                | 0 - 1,000,000 <sup>2</sup> |
| kVAR                 | class 0.2       | 0.1%                | 0 - 1,000,000 <sup>2</sup> |
| kVA                  | class 0.2       | 0.1%                | 0 - 1,000,000 <sup>2</sup> |
| Power Factor         | 0.2%            | 1.0%                | 1.0 to ±0.6                |
| Frequency            | 0.005 Hz        | 0.1 Hz <sup>3</sup> | 40 to 450 Hz               |
| kW Demand            | class 0.2       | 0.1%                | 0 - 1,000,000              |
| Amps Demand          | class 0.2       | 0.1%                | 0 - 30,000                 |
| kWH (-F, -R)         | class 0.2       | 1 kWH               | 0 - 1,000,000,000          |
| kVARH (-F, -R)       | class 0.2       | 1 kVARH             | 0 - 1,000,000,000          |

- .1 Reads in kV for voltages over 9,999.
- .2 Reads in MVA, MW, MVAR for readings over 9,999 K.
- .3 1 Hz resolution at 400 Hz range.
- .3 Power Supply
  - .1 85 to 250 VAC or 110 to 300 VDC
  - .2 Burden: 15 VA typical, 35 VA maximum.

**METERING AND SWITCHBOARD INSTRUMENTS**

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**2.2 Potential Transformers**

- .1 Provide three (3) potential transformers.
- .2 Provide Instrument PTs that are independent of protection PTs

**2.3 Current Transformers**

- .1 Provide shorting switches or test blocks for all meter CT inputs.
- .2 Provide Instrument CTs that are independent of protection CTs

**2.4 Equipment Identification**

- .1 Provide equipment identification in accordance with **Section 16010 – Electrical General**.

**2.5 Energy Management Software**

- .1 ION Enterprise, version upgrades till December 31, 2008.
- .2 Licenses for thirty (30) devices

**3. EXECUTION**

**3.1 Field Testing and Inspection**

- .1 Conduct tests in accordance with Manufacturer's recommendations.
- .2 Perform simulated operation tests with metering, instruments disconnected from permanent signal and other electrical sources.
- .3 Verify correctness of connections, polarities of meters, instruments, potential and current transformers, transducers, signal sources, and electrical supplies.

**3.2 Installation**

- .1 Mount in the control section of the appropriate switchgear breaker cubicle or adjacent meter compartment.
- .2 Install appropriate potential transformer and current transformers required for sensing signals for the meter system.
- .3 Install, wire, and connect all electrical circuits to the instrumentation package and provide wiring to an external terminal strip for the relay outputs, digital status inputs and analog output port.

**METERING AND SWITCHBOARD INSTRUMENTS**

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- .4 Install, wire and connect the communications port of each meter and extend communications wiring to a location that is easily and safely accessible to facilitate diagnostics, testing, and firmware upgrades.

**END OF SECTION**

## INSTRUMENT TRANSFORMER

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### 1. GENERAL

#### 1.1 References

- .1 CAN3-C13, Instrument Transformers.

#### 1.2 Product Data

- .1 Submit product data in accordance with **Section 01300 – Submittals**.
- .2 Indicate dimensions and connection details.

### 2. PRODUCTS

#### 2.1 Potential Transformers

- .1 Potential Transformers: To CAN3-C13, dry type for indoor use, with following characteristics:
  - .1 Nominal Voltage Class: 4.16 kV
  - .2 Rated Frequency: 60 Hz
  - .3 Basic Impulse Level: 6 kV
  - .4 Voltage Ratio: 4160:120
  - .5 Accuracy Rating: 0.3B2.0.
- .2 Potential Transformers fused with separate fuse block.

#### 2.2 Current Transformers

- .1 Current Transformers: To CAN3-C13, dry type for indoor use with following characteristics:
  - .1 Nominal Voltage Class: 4.16 kV
  - .2 Rated Frequency: 60 Hz
  - .3 Basic Impulse Level: 60 kV
  - .4 Metering Accuracy Ratio: 0.3B2.0
  - .5 Relay Accuracy Rating: 2.5H100
  - .6 Rated Primary and Secondary Current: as indicated on Plans



## **INSTRUMENT TRANSFORMER**

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- .7 Continuous-Current Rating Factor: 150%
- .8 Short-Time Mechanical Current Rating: one and a half (1.5) times primary rating
- .9 Short-Time Thermal Current Rating: one and a half (1.5) times primary rating.
- .2 Positive action automatic short-circuiting device in secondary terminals.

### **2.3 Mounting Brackets**

- .1 Potential transformers with channel type mounting brackets.
- .2 Fabricate brackets and channels from electro-galvanized code gauge painted steel.

## **3. EXECUTION**

### **3.1 Installation**

- .1 Install instrument transformers and ensure accessibility.

**END OF SECTION**

## **GROUNDING - SECONDARY**

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### **1. GENERAL**

#### **1.1 Description**

- .1 Analyze the entire grounding system for the City of Winnipeg Water Treatment Program in accordance with the requirements of all related sections in the latest Canadian Electrical Code (CEC) and the local Electrical Inspection Branch. Perform all necessary calculation to identify all requirements for the grounding system. All calculations shall be signed and sealed by a Professional Engineer registered in the Province or Manitoba and shall be submitted to the Contract Administrator for review.
- .2 Supply all equipment and hardware required for the installation, except for field installed ground cable, ground rods, and connectors.
- .3 Determine the neutral grounding for the two (2) station transformers and the standby power generators. The grounding system shall limit the single phase to ground fault current to 200 amps in the following modes of operation: normal, standby generator (isolated from utility), generators synchronized to utility. The grounding system shall limit the single phase to ground fault current to 400 amps during closed transition switching of the primary 4.16 kV switchgear breaker BK-E100C. The grounding shall allow for ground fault detection and tripping on all feeders regardless of operating mode.
- .4 Determine the number of poles required on transformer, tie, and generator breakers to provide proper operation of the system grounding and ground fault detection/tripping.
- .5 The system is to consist of neutral grounding resistors, ground fault relays, cables, ground rods, supports, and all necessary materials and inter-connections to provide a complete system.
- .6 The grounding grid for the two (2) 66 kV/4160 V service transformers will provided by Manitoba Hydro. Coordinate the grounding system analysis with the utility. Comply with the utility requirements.
- .7 The grounding system shall consist of the grounding grid for the two (2) 66 kV/4160 V transformers, and shall incorporate the grounding scheme for the 4160 V and 600 V systems in the Deacon Booster Pump Station (DBPS), and four (4) 4160 V/600 V transformers and the 600 V distribution systems in the new Water Treatment Plant.
- .8 The analysis shall include grounding grids for four (4) 4160 V/600 V pad mount transformers.
- .9 The soil in the location of the ground grid has been excavated for other construction in the area. The Contractor is advised that the ground grid will be installed in/on disturbed soil.
- .10 The step and touch potential limits in the design of the ground grid shall be such that the City will be able to install vegetation up to the edge or the concrete base for the pad mount transformers.

## **GROUNDING - SECONDARY**

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### **1.2 References**

- .1 American National Standards Institute/Institute of Electrical and Electronic Engineers (ANSI/IEEE) 837, Qualifying Permanent Connections Used in Substation Grounding.
- .2 IEEE-32-1972, Standard Requirements, Terminology, and Test Procedures for Neutral Grounding Devices.

### **1.3 Shop Drawings**

- .1 Submit Shop Drawings and calculations for the grounding analysis in accordance with **Section 01300 – Submittals**.
- .2 Contractor shall submit the following information to the Contract Administrator as specified in D15:
  - .1 Grounding Grid calculations and layout schematic for the transformers and generators sealed by Professional Engineer registered in the Province of Manitoba.
  - .2 Fault level calculations including but not limited to 5 kV main switch gear, generator switch gear, 600 V main electrical room distribution center, and chemical building electrical room distribution center.
  - .3 Transformer grounding requirements, generator(s) grounding requirements, including information on transformer and generator(s) neutral grounding resistors.
  - .4 Dimensioned Drawings for mounting of the neutral grounding resistors.

### **1.4 Maintenance Materials**

- .1 Provide maintenance data for grounding system for incorporation into manual specified in **Section 01730 – Operation Maintenance Manuals**.

### **1.5 Delivery and Storage**

- .1 Ship the equipment suitably protected from damage during transportation.

## **2. PRODUCTS**

### **2.1 Equipment**

- .1 Grounding conductors: bare stranded copper, soft annealed, size 4/0.
- .2 Copper conductor: minimum 6 m long for each concrete encased electrode, bare, stranded, tinned, soft annealed, size as indicated.
- .3 Rod electrodes: copper clad steel 19 mm diameter by 3 m long.

## **GROUNDING - SECONDARY**

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- .4 In the main electrical room, provide a copper ground bar complete with lugs suitable to terminate all ground cables.
- .5 Non-corroding accessories necessary for grounding system, type, size, material as indicated, including but not necessarily limited to:
  - .1 Grounding and bonding bushings.
  - .2 Protective type clamps.
  - .3 Bolted type conductor connectors for above grade accessible connections
  - .4 Thermit welded type conductor connectors for below grade or inaccessible connections
  - .5 Bonding jumpers, straps.
- .6 Neutral Grounding Resistor:
  - .1 Indoor drip proof enclosure, 2400 V line to ground, 200 amps 10 seconds rated.
  - .2 Resistor element to be stainless steel.
  - .3 Provided with a resistor-open-circuit detection monitor.
  - .4 The neutral grounding resistor shall be provided with a ground current sensing device. The ground current sensing instrument and associated relay shall be Startco SE-330 NGR Monitor c/w Modbus TCP communications and all necessary accessories, or approved equal.

### **2.2 Grounding Grid**

- .1 Provide detail requirements for the grounding grid System for the four (4) 4160 V/600 V pad mount transformers, the electrical distribution and generation building, and associated equipment. Ground grid shall follow the IEEE 80 and IEEE Guide for Safety in AC Substation Grounding standards.
- .2 Conduct a soil resistivity test On-Site and include the soil resistivity value in the Step-and-Touch voltage calculation and in the analysis of the Grounding Grid. The Contractor is advised that all soil On-Site will be disturbed as a result of on going construction. The calculations shall be signed and sealed by a Professional Engineer registered in Manitoba.
- .3 The Grounding Grid shall consist of ground rods driven to permanent moisture and interconnected by a grid system of bare, soft annealed copper conductors.
- .4 The Grounding Grid shall follow the requirements of the Step-and-Touch voltage limits specified in Canadian Electrical Code Table 52 and in accordance with Step-and-Touch voltage calculations specified in IEEE Standard 80 including the following:

## **GROUNDING - SECONDARY**

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- .1 Clearing time – the default is 60 cycles unless a faster time can be demonstrated.
- .2 Soil model shall consist of at least three (3) layers.
  - .1 Top layer – 25 mm with a resistivity of 5 ohm-m.
  - .2 Middle layer – 1.5 m frozen ground.
  - .3 Bottom layer – natural soil, resistivity determined by On-Site testing.
- .5 Submit the Step-and-Touch voltage calculations signed and sealed by a Professional Engineer registered in Manitoba and the Grounding Grid schematics to the Contract Administrator for review.

### **3. EXECUTION**

#### **3.1 General**

- .1 Installation by others.

#### **3.2 Field Quality Control**

- .1 After installation perform ground continuity and resistance tests using method appropriate to Site conditions and to approval of Contract Administrator and Manitoba Hydro
- .2 Perform tests before energizing electrical system.
- .3 Disconnect ground fault indicator during tests.

**END OF SECTION**

## **POWER GENERATION - DETAIL**

---

### **1. GENERAL**

#### **1.1 Description of System**

- .1 The electric power generating system shall consist of two (2) or three (3) generators providing a total site capability of at least 6000 ekW at 0.8 power factor, 4160 V, wye connected, 3 phase, 60 Hz. This power shall be applied for Standby operation. All generators shall be of the same capacity.
- .2 Generation system consists of:
  - .1 Engine.
  - .2 Engine/alternator common base plate.
  - .3 Free-standing generator control switchboard.
  - .4 Engine-driven fan and unit-mounted radiator.
  - .5 Battery charger and battery.
  - .6 Fuel system and accessories.
  - .7 Cooling air ventilation system accessories.
  - .8 Engine exhaust silencer, flex actions and accessories.
  - .9 Alternator output circuit breaker in common enclosure, mount with control panel.
  - .10 Vibration isolators.
  - .11 Factory testing.
  - .12 Site delivery.
  - .13 Installation support and performance verification.
  - .14 Generator.
- .3 Design generator set and automatic transfer switch system for automatic standby power.
- .4 In addition to automatic standby operation, the system shall be capable of peak shaving. Peak shaving mode shall be manually initiated. During peak shaving mode the power output shall be automatically adjusted to a maximum of the prime power rating.
- .5 The system shall consist of generator sets, which include all controls, protection, wiring, and accessories for automatic start-stop operation.

**POWER GENERATION - DETAIL**

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- .6 Generator set to include automatic shutdown and alarm indication for:
  - .1 Low oil pressure.
  - .2 High coolant temperature.
  - .3 Overspeed.
  - .4 Over-crank.
  - .5 Emergency stop.
- .7 Generator set to include warning systems and indication for:
  - .1 Low coolant temperature.
  - .2 Coolant temperature rising
  - .3 Low daytime tank fuel.
  - .4 Low battery voltage.
  - .5 Low coolant level.
  - .6 Ventilation dampers not open.
  - .7 Day time leak detection.
  - .8 Generator output breaker open.
  - .9 Selector switch “not in automatic” position.
- .8 Generator control system shall be connected to the Supervisory Control and Data Acquisition (SCADA) system for remote monitoring and control. All information and control available at the local generator Operator Interface shall be made available to the SCADA system utilizing Modbus/TCP.

**1.2 Standards**

- .1 Canadian electrical code (CEC) and provincial and local amendments.
- .2 Manitoba Building Code.
- .3 Local building code.
- .4 National Electrical Manufacturers Association (NEMA) Motor and Generator Standards.
- .5 Canadian Standards Association (CSA) Standard C282 – Emergency Electrical Power Supply in Building.

## POWER GENERATION - DETAIL

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### 1.3 System Performance, General

- .1 Rating - Engine brake horsepower shall be sufficient to deliver full rated generator set kW/kVA when operated at rated rpm and equipped with all engine-mounted parasitic and external loads such as radiator fans and power generators.
- .2 Conditions - The rating shall be based on Organization for International Standardization (ISO) 3046/1 standard conditions of 100 kPa and 27C (29.53 in Hg, 81F); BS 5514, DIN 6271, SAE J1349 and API 7B-11C also apply.
- .3 Fuel - Diesel engines shall be able to deliver rated power when operating on No. 2 diesel fuel having 35° API (16°C, 60°F) specific gravity.
- .4 Fuel Consumption - Diesel fuel rates shall be based on fuel having a low heating value (LHV) of 42,780 kJ/kg (18,355 Btu/lb.) when used at 29°C (85°F) and weighing 838.9 g/l (7.001 lbs./U.S. gal).
- .5 Start Time and Load Acceptance - Engines shall start, achieve rated voltage and frequency, and be capable of accepting load within ten (10) seconds when properly equipped and maintained.
- .6 Block Load Acceptance - Transient response shall conform to ISO 8528 requirements.

### 1.4 Shop Drawings

- .1 Submit Shop Drawings in accordance with **Section 01300 – Submittals**.
- .2 Shop Drawings to include:
  - .1 Schematic power and control diagrams showing generator, voltage regulator, metering, battery, battery charger, governor, and all engine/generator protection and controls. Indicate all field connection requirements.
  - .2 Make and model of engine, generator, governor, voltage regulator, battery charger, battery, exhaust silencer, block heater/thermostat, vibration isolators, control devices, and power components, complete with technical and performance data.
  - .3 Confirmation that the generator set will comply with 100% shop load performance requirements.
  - .4 Dimensioned Drawings for alternator, engine, control switchboard, and all accessories.
  - .5 Indication of all anchoring/mounting locations, and all power/control connection locations.
  - .6 Fuel day tank storage and delivery system, flow rating, flow diagram, and relevant data.
  - .7 Generator room ventilation system requirements



### **POWER GENERATION - DETAIL**

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- .8 Confirmation that required engine power at 100% rated load condition, 0.8 PF, does not exceed the engine Manufacturer's recommended standby power rating.
- .9 Manufacturer's published stand by power output curves and fuel consumption curves.
- .10 Description of set operation including:
  - .1 Automatic starting and transfer to load and back to normal power, including time in seconds from start of cranking until unit pressures rated voltage and frequency.
  - .2 Automatic shutdown and alarm on.
    - .1 Over-cranking.
    - .2 Overspeed.
    - .3 High engine temperature.
    - .4 Low lube oil pressure.
    - .5 Short circuit.
    - .6 Alternator over voltage.
    - .7 Lube oil high temperature.
    - .8 Over temperature on alternator.
    - .9 Manual remote emergency stop.
  - .11 Modbus register mapping for connection to the SCADA system.

#### **1.5 Operation and Maintenance Data**

- .1 Provide operation and maintenance (O&M) data for diesel generator for incorporation into manual specified in **Section 01730 – Operation and Maintenance Manuals**.
- .2 Include in O&M manual instructions for particular unit supplied and not general description of units manufactured by supplier, and:
  - .1 O&M instructions to permit effective operation, maintenance, and repair for engine, alternator, control panel, automatic transfer switch, manual bypass switch, battery charger, battery, fuel system, generator room, ventilation system, exhaust system, and accessories.
  - .2 Technical data:
    - .1 Illustrated parts list with parts catalogue numbers.

**POWER GENERATION - DETAIL**

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- .2 Schematic diagram of electrical controls.
  - .3 Flow diagrams for:
    - .1 Fuel system.
    - .2 Lubricating system.
    - .3 Cooling system.
  - .4 Certified copy of factory test results.
  - .5 Maintenance and overhaul instructions and schedules.
  - .6 Precise details for adjustment and setting of time delay relays or sensing controls which require On-Site adjustment.
- .3 Manufacturer's Quality Assurance Procedures Manual.
  - .4 Certified copy of factory test results.
  - .5 Copy of guarantee.
  - .6 Complete set of as-built physical, schematic, and wiring diagrams and complete installation instructions.

**1.6 Maintenance Materials**

- .1 Provide maintenance materials.
- .2 Include:
  - .1 Four (4) fuel filter replacement elements.
  - .2 Four (4) lube oil filter replacement elements.
  - .3 Four (4) air cleaner filter elements.
  - .4 Four (4) Sets of fuses for control panel.
  - .5 Four (4) of each type of indicating lamps.
  - .6 Two (2) sets of 'fan' belts.
  - .7 One (1) set of complete tools for routine servicing.

## POWER GENERATION - DETAIL

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### 1.7 Source Quality Control

- .1 Factory test generator set including engine, alternator, control panel, and accessories in presence of the Contract Administrator.
- .2 Notify the Contract Administrator twenty (20) working days in advance of factory test.
- .3 The generator set and accessories are to be tested and manufactured in accordance with the Manufacturer's quality assurance program. The programs to comply with the intent, or CSA CAN3-Z299.3, or ISO 9001. Provide a copy of the Manufacturer's quality assurance procedures manual.
- .4 Test procedure:
  - .1 Prepare blank forms and check sheet with spaces to record data. At top of first sheet record:
    - .1 Date and location.
    - .2 Generator set serial number.
    - .3 Engine make, model, and serial number.
    - .4 Alternator make, model, and serial number.
    - .5 Voltage regulator make and model.
    - .6 Rating of generator set, kW, kVA, volts, amps, RPM, Hz.
  - .2 Mark check sheet and record data on forms, as test proceeds.
  - .3 Provide reactive type load bank and related controls to allow testing, including 100% step loads. Provide all necessary instrumentation and recording equipment.
  - .4 Obtain Contract Administrator's signature on completed forms to indicate concurrence in results of tests.
  - .5 Indicate name of test operator.
- .5 Test
  - .1 Perform functional and load tests to verify conformance with codes and Specifications.
  - .2 Tests are to include:
    - .1 Automatic shutdown devices and trouble alarms. Tests to include actual out-of-limits operation with protective devices in their installed and in-service condition to prove sensor operation within Manufacturer's recommended limits.

**POWER GENERATION - DETAIL**

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- Jumper testing of sensors or remote simulation testing to prove shutdowns are not permissible.
- .2 Automatic start-up, transfer to load, transfer back to normal power, cool down, and shutdown.
  - .3 Demonstrate the battery reverts to high rate charge after cranking.
- .6 Perform a four (4) hour full load acceptance test, using a 100% rated resistive load bank or rated Plant load, as follows:
- .1 With 100% rated load, operate set for eight (8) hours, taking readings at fifteen (15) minute intervals, and record the following:
    - .1 Time of reading.
    - .2 Running time.
    - .3 Ambient temperature in °C.
    - .4 Lube oil pressure in kPa.
    - .5 Lube oil temperature in °C.
    - .6 Engine coolant temperature in °C.
    - .7 Exhaust stack temperature in °C.
    - .8 Alternator voltage: phase 1, 2, 3.
    - .9 Alternator current: phase 1, 2, 3.
    - .10 Power in kW.
    - .11 Frequency in Hz.
    - .12 Power factor.
    - .13 Battery charger current in A.
    - .14 Battery voltage.
    - .15 Alternator cooling air outlet temperature.
  - .2 After completion of four (4) hour run, demonstrate following shutdown devices and alarms:
    - .1 Over-cranking.

**POWER GENERATION - DETAIL**

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- .2 Overspeed.
  - .3 High engine temperature.
  - .4 Low lube oil pressure.
  - .5 Short circuit.
  - .6 Alternator over-voltage.
  - .7 Low battery voltage, or no battery charge.
  - .8 Manual remote emergency stop.
  - .9 High alternator temperature.
- .7 Next, install continuous strip chart recorders or digital residing devices to record frequency and voltage variations during load switching procedures. Each load change delayed until steady state conditions exist. Switching increments to include:
- .1 No load to full load to no load.
  - .2 No load to 70% load to no load.
  - .3 No load to 20% load to no load.
  - .4 20% load to 40% load to no load.
  - .5 40% load to 60% load to no load.
  - .6 60% load to 80% load to no load.

**1.8 Delivery**

- .1 Store generator set and accessories in an indoor, dry, heated location until delivered to the Site.
- .2 Coordinate Site delivery with the Contract Administrator.
- .3 Coordinate lifting, handling, and placing requirements of all items.

**2. PRODUCTS**

**2.1 Diesel Engine**

- .1 Diesel Engine: to ISO 3046/1.

**POWER GENERATION - DETAIL**

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- .1 Engine: standard product of current Manufacturer, from company regularly engaged in production of such equipment.
- .2 Turbo charged and after-cooled, synchronous speed 1800 r/min.
- .3 Capacity:
  - .1 Rated continuous power in kW at rated speed, after adjustment for system losses in auxiliary equipment necessary for engine operation, to be calculated as follows:  
$$\text{Rated continuous output} = \frac{\text{Generator kW}}{\text{Generator Eff W FL}}$$
  - .1 Under following site conditions:
    - .1 Altitude: 300 m.
    - .2 Ambient temperature: 30°C.
  - .2 Engine overload capability 110% of continuous output for one (1) hour within twelve (12) hour period of continuous operation.
- .3 Cooling System:
  - .1 Liquid cooled: heavy duty industrial radiator mounted on generating set base with engine driven pusher type fan to direct air through radiator from engine side, with ethylene glycol anti-freeze, non-sludging above minus 46°C.
  - .2 To maintain manufacturer's recommended engine temperature rate at 10% continuous overload in ambient temperature of 40°C.
  - .3 Block heater: thermostatically controlled lube oil or liquid cooled heater connected to line side of automatic transfer switch to allow engine to start in room ambient 0°C.
    - .1 Switch and fuse in heater circuit, mounted in engine-alternator control cubicle and fed from line side of automatic transfer switch.
- .4 Fuel:
  - .1 Arctic Grade 2: to CGSB 3-GP-6c.
- .5 Fuel System: Solid injection, mechanical fuel transfer pump with hand primer, fuel filters and air cleaner, fuel rack solenoid energized when engine running.
- .6 Fuel/Water Separator:
  - .1 A fuel/water separator shall protect the fuel system from water damage.
- .7 Fuel Cooler:

**POWER GENERATION - DETAIL**

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- .1 Fuel shall be piped from the filter/water separators to the intake of the engine fuel pump, and then to the engine. Excess fuel shall be piped through the fuel cooler and returned to the fuel tank with less than 60 kPa (8.7 psi) restriction. The fuel cooler shall be capable of exchanging heat rejected with the cooling medium under all loading conditions, including 10% reserve to accommodate fouling.
- .8 Governor:
    - .1 Electronic load sharing type, electric actuator, speed droop externally adjustable from isochronous to 5% temperature compensated with steady state speed maintenance capability of plus or minus 0.25%.
- .9 Lubrication System:
    - .1 Pressure lubricated by engine driven pump.
    - .2 Pre-lube pump c/w motor starter and pump start stop control with timer, for operation 15 min on/15 min. off.
    - .3 Turbo charger to have both pre-run and post-run lubrication systems.
    - .4 Lube oil filter: replaceable, full flow type, removable without disconnecting piping.
    - .5 Lube oil cooler.
    - .6 Engine sump drain valve.
    - .7 Oil level dip-stick.
- .10 Starting System:
    - .1 Heavy duty dual positive shift, gear engaging starters 24 VDC.
    - .2 Cranking limiter to provide six (6) cranking periods of ten (10) second durations, each separated by five (5) seconds of rest.
    - .3 Lead acid, 24 V storage battery with sufficient capacity to crank engine for one (1) minute at 0°C without using more than 25% of ampere hour capacity.
    - .4 Two (2) CSA approved jacket water heaters with thermostatic control to maintain engine temperature at a sufficient level to maintain normal engine starting temperatures. Jacket water heaters to include a circulating pump and isolation valves. Control voltage shall be 24 VDC and pump rating minimum 35 liters/minute.
    - .5 Battery Charger: constant voltage, solid state, two stage from trickle charge at standby to boost charge after use. Regulation: plus or minus 2% output for plus or minus 10% input variation. Equipped with DC voltmeter, DC ammeter, and on-off switch. Minimum charger capacity: 7 A.

**POWER GENERATION - DETAIL**

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- .11 Vibration Isolation Engine Instrument Panel with:
  - .1 Lube oil pressure display.
  - .2 Lube oil temperature display.
  - .3 Coolant temperature display.
  - .4 Coolant level display.
  - .5 Running time meter: non-tamper type.
- .12 Guards to protect personnel from hot and moving parts. Locate guards so that normal daily maintenance inspections can be undertaken without their removal.
- .13 Drip tray.

**1.2 Alternator**

- .1 Alternator: to American National Standards Institute/National Electrical Manufacturer's Association (ANSI/NEMA) MG1.
- .2 Rating: 3 phase, 4160 V 4 wire, impedance grounded.
- .3 Output at 40°C ambient:
  - .1 100% full load continuously.
  - .2 110% full load for one (1) hour.
  - .3 150% full load for one (1) minute.
- .4 Revolving field, brushless, single bearing.
- .5 Drip-proof.
- .6 Amortisseur windings.
- .7 Synchronous type.
- .8 Dynamically balanced rotor permanently aligned to engine by flexible disc coupling.
- .9 Exciter: rotating brushless permanent magnet.
- .10 Electrical and Electronic Manufacturer's Association of Canada (EEMAC) class H insulation of windings.
- .11 Platinum resistance temperature transducers embedded in stator winding and connected to alternator control circuitry.



## **POWER GENERATION - DETAIL**

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- .12 Voltage regulator: thyristor controlled rectifiers with phase controlled sensing circuit:
  - .1 Stability:  $\pm 0.5\%$  maximum voltage variation at any constant load from no load to full load.
  - .2 Regulation:  $\pm 0.5\%$  maximum voltage deviation between no-load steady state and full load steady state.
  - .3 Transient:  $\pm 0.5\%$  maximum voltage dip on one-step application of 0.8 PF full load.
  - .4 Transient:  $\pm 0.5\%$  maximum voltage rise on one-step removal of 0.8 PF full load.
  - .5 Transient: one (1) second maximum voltage recovery time with application or removal of 0.8 PF full load.
  - .6 The regulator shall include a reactive droop network to allow paralleling with other alternator. The network shall consist of current transformer, rheostat, and control circuit, which shall provide 8% minimum droop at full load and 0.8 PF.
- .13 Alternator: capable of sustaining 300% rated current for period not less than ten (10) second permitting selective tripping of down line protective devices when short circuit occurs.
- .14 Space heater rated at 1200 watt, 120/240 V.
- .15 Generator bearing RTDs.

### **1.3 Control Panel**

- .1 Totally enclosed, free standing mounting base isolated from diesel generator.
- .2 Audiovisual Annunciation with National Fire Protection Association (NFPA) 110 Level 1 and CSA C282 capability.
- .3 Programmable microprocessor logic and digital display features.
- .2 Instruments:
  - .1 Digital, 100% solid state circuitry, 2% accuracy, rectangular face, and flush panel mounting:
    - .1 Voltmeter: AC, scale 0 to 5000 V
    - .2 Ammeter: AC, scale 0 to 500 A
    - .3 Wattmeter: scale 0 to 2500 kW
    - .4 Frequency meter: scale 55 to 65 Hz
    - .5 kVAR meter

**POWER GENERATION - DETAIL**

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- .6 kWh meter.
- .2 Provide instrument displays via a touch screen graphics display
- .3 Instrument Transformers
  - .1 Potential-dry type for indoor use:
    - .1 Ratio: 5000 to 120.
    - .2 Rating: 5000V, 60 Hz, BIL 60 kV.
  - .2 Current-dry type for indoor use:
    - .1 Ratio: 600 to 5.
    - .2 Rating: 600 V, 60 Hz, BIL 10 kV.
    - .3 Positive action automatic short-circuiting device in secondary terminals.
  - .3 Controls:
    - .1 Engine start button.
    - .2 Selector switch: Off-Auto-Manual – [Test full load test no load].
    - .3 Engine emergency stop button and provision for remote emergency stop button.
  - .4 Voltage control setting in control panel.
  - .5 Operating lights, panel mounted:
    - .1 “Normal power” pilot light.
    - .2 “Emergency power” pilot light.
    - .3 Green pilot lights for breaker on and red pilot lights for breaker off.
  - .6 Solid state indicator lights for alarm with two (2) sets manually reset NO/NC contacts wired to terminal block for remote annunciation on:
    - .1 Low daytime tank fuel level.
    - .2 Low battery voltage.
    - .3 Ventilation failure.
    - .4 Low coolant temperature.

## **POWER GENERATION - DETAIL**

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- .5 Coolant temperature rising
- .6 Low daytime tank fuel.
- .7 Low coolant level.
- .8 Day time leak detection.
- .9 Generator output breaker open.
- .10 Selector switch “not in automatic” position.
- .7 Solid state controller and indicator lights for automatic shutdown and alarms with two (2) sets manual reset NO/NC contacts wired to terminal block for remote annunciation on:
  - .1 Engine over-crank.
  - .2 Engine overspeed.
  - .3 Engine high temperature.
  - .4 Engine low lube oil pressure.
  - .5 Short circuit.
  - .6 AC over-voltage.
  - .7 Emergency stop.
  - .8 Lamp test button.
  - .9 Synchronization and load sharing.
  - .10 Provision for remote monitoring.
  - .11 Programmable logic controller (PLC) – Refer to **Division 17** for Specifications
  - .12 Operator Interface – Refer to **Division 17** for Specifications

### **1.4 Automatic Transfer Switchboard**

- .1 See **Section 16627 – Automatic Load Transfer Equipment.**

### **1.5 Steel Mounting Base**

- .1 Complete generating set mounted on structural steel base of sufficient strength and rigidity to protect assembly from stress or strain during transportation, installation, and under operating conditions on suitable level surface.

## **POWER GENERATION - DETAIL**

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- .2 Assembly fitted with vibration isolators.
  - .1 Spring-type isolators with adjustable side snubbers and adjustable for levelling.
- .3 Sound insulation pads for installation between isolators and concrete base.
- .4 Fasten steel base to floor, to withstand seismic forces

### **1.6 Exhaust System**

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

### **1.7 Fuel Tank System**

- .1 Fuel storage tanks: to ANSI/API 650, Underwriter's Laboratories of Canada (ULC) labelled.
  - .1 Tank: to ULC S601 and CSA B139.
- .2 Day Tank:
  - .1 Double wall sub-base fuel tank. Sized for four (4) hours operation at 100% load
  - .2 Manual fill inlet with overflow prevention.
  - .3 Fuel supply from remote tank.
  - .4 Overflow return to main tank.
  - .5 Vent fitting.
  - .6 Engine fuel transfer pump.
  - .7 Fuel transfer control level switches: pump start, pump stop, high alarm, low alarm.
- .3 Fuel Transfer System
  - .1 Specified in **Division 15**.
- .4 Outdoor Storage Tank

**POWER GENERATION - DETAIL**

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- .1 Specified in **Division 15**.

**1.8 Finishes**

- .1 Alternator control cubicle: paint inside, exterior to match engine and alternator.
- .2 Exhaust and inlet air hoods:
- .3 Other ducts and racks: grey.
- .4 Supply 0.25 L of grey touch-up enamel.

**1.9 Equipment Identification**

- .1 Provide equipment identification in accordance with **Section 16010 – Electrical General Requirements**.
- .2 Control Panel:
  - .1 Nameplates for controls such as alternator breakers and program selector switch.
  - .2 Nameplates for meters, alarms, indicating lights, and minor controls.

**1.10 Fabrication**

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

**1.11 Acceptable Manufacturers**

- .1 Caterpillar, Cummins.

**2. EXECUTION**

**2.1 Installation**

- .1 Installation by others.

**POWER GENERATION - DETAIL**

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- .2 Provide installation assistance in accordance with **Section 01650 – Equipment Installation.**

**2.2 Field Quality Control and Testing**

- .1 Provide performance tests in accordance with **Division 1.**
- .2 Operation of all components to be demonstrated – battery charger, alarm devices, transfer switch, block heaters, controls, and all other components making up the overall system.
- .3 Using a resistive load bank, 100% of alternator rating, perform a running test of all equipment and record the following:
- .1 Engine oil pressure.
  - .2 Water temperature.
  - .3 Cranking time to start.
  - .4 Time to achieve standby power operation.
  - .5 Time delay on start.
  - .6 Time delay on retransfer to normal.
  - .7 Voltage current, every fifteen (15) minutes, for one (1) hour.
- .4 Perform an eight (8) hour full load running test, using a 100% rated resistive load bank or rated Plant load, as follows:
- .1 With 100% rated load, operate set for eight (8) hours, taking readings at fifteen (15) minute intervals, and record the following:
    - .1 Time of reading.
    - .2 Running time.
    - .3 Ambient temperature in °C.
    - .4 Lube oil pressure in kPa.
    - .5 Lube oil temperature in °C.
    - .6 Engine coolant temperature in °C.
    - .7 Exhaust stack temperature in °C.
    - .8 Alternator voltage: phase 1, 2, 3.
    - .9 Alternator current: phase 1, 2, 3.

**POWER GENERATION - DETAIL**

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- .10 Power in kW.
- .11 Frequency in Hz.
- .12 Power factor.
- .13 Battery charger current in A.
- .14 Battery voltage.
- .15 Alternator cooling air outlet temperature.
- .2 After completion of eight (8) hour run, demonstrate following shutdown devices and alarms:
  - .1 Over-cranking.
  - .2 Overspeed.
  - .3 High engine temperature.
  - .4 Low lube oil pressure.
  - .5 Short circuit.
  - .6 Alternator over-voltage.
  - .7 Low battery voltage, or no battery charge.
  - .8 Manual remote emergency stop.
  - .9 High alternator temperature.
- .5 Next, install continuous strip chart recorders or digital residing devices to record frequency and voltage variations during load switching procedures. Each load change delayed until steady state conditions exist. Switching increments to include:
  - .1 No load to full load to no load.
  - .2 No load to 70% load to no load.
  - .3 No load to 20% load to no load.
  - .4 20% load to 40% load to no load.
  - .5 40% load to 60% load to no load.
  - .6 60% load to 80% load to no load.

## **POWER GENERATION - DETAIL**

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- .6 Demonstrate:
  - .1 Automatic starting of set and automatic transfer of load on failure of normal power.
  - .2 Operation of manual bypass switch.
  - .3 Automatic shutdown of engine on resumption of normal power.
  - .4 That battery charge reverts to high rate charge after cranking.
  - .5 Peak shaving
  - .6 Soft loading and unloading.
- .7 Demonstrate low oil pressure and high engine temperature shutdown devices operation without subjecting engine to these excesses.

### **2.3 Vibration Analysis**

- .1 Perform an On-Site vibration analysis of the new diesel engine generator package units under no load and full load conditions as further specified herein.
- .2 Submit a complete vibration analysis report to the consultant. Report shall include a sketch of the engine generator sets showing the points at which the analysis took place, copies of the vibration signature at each point and a summary sheet.
- .3 Vibration analysis shall be conducted at each of the following points:
  - .1 Front (fan end) of engine.
  - .2 Rear (drive end) of engine.
  - .3 Front (driven end) generator.
  - .4 Rear (exciter end) of generator.
  - .5 Front of base (at vibration isolators).
  - .6 Midpoint of base (between isolators).
  - .7 Rear of base (at vibration isolators).

Exact locations of analysis points shall be as directed On-Site. Each point shall be permanently marked and numbered with a lamacioid nameplate on each unit to ensure that future readings are conducted in the same location.

- .4 Vibration analysis shall include horizontal, vertical, and axial readings at each analysis point exact that axial readings may be omitted for points in the middle of the generating set and on the base of the unit.



**POWER GENERATION - DETAIL**

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- .5 Vibration analysis shall be conducted using a vibration analyser in conjunction with a chart recorder to produce a continuous vibration signature at each analysis point in each direction of vibration. (total of thirty two (32) signatures required). Each vibration signature shall show both vibration amplitude in mils and velocity in inches/second as a function from 200 cycles per minute to 200,000 cycles per minute.

**2.4 Training**

- .1 Provide demonstration and training in accordance with **Division 1**.

**END OF SECTION**

## **AUTOMATIC LOAD TRANSFER EQUIPMENT**

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### **1. GENERAL**

#### **1.1 Reference Standards**

- .1 CAN3-C13, Instrument Transformers.
- .2 CAN3-C17, Alternating-Current Electricity Metering.
- .3 American National Standards Institute/National Electrical Manufacturer's Association (ANSI/NEMA) ICS 2, Industrial Control Devices, Controllers, and Assemblies.
- .4 Manitoba Hydro, Interconnection Guideline, DRG2003.

#### **1.2 System Description**

- .1 Automatic load transfer control for single utility source power failure and dual utility source power failure:
  - .1 Monitor voltage on all phases of normal power supplies.
  - .2 Transfer load from failed utility source to second utility source.
  - .3 Initiate cranking of standby generator unit(s) on power failure or abnormal voltage on any one phase below preset adjustable limits for adjustable period of time on both utility sources.
  - .4 Transfer load from normal supply to standby generator unit(s) when standby generator unit reaches rated frequency and voltage pre-set adjustable limits by controlling motorized vacuum breakers in the MV switchboards.
  - .5 Transfer load from standby generator unit(s) to normal power supply when normal power restored, confirmed by sensing of voltage on all phases above adjustable pre-set limit for adjustable time period in closed transition fashion so as not to shut down the process restarted under emergency conditions.
  - .6 Soft unload of standby generator unit(s) and shut down after running unloaded to cool down using adjustable time delay relay.
  - .7 Use plant equipment as a load bank during monthly testing with a baseload controller so as not to exceed the current plant load and export power back to the grid.
  - .8 Load shedding during baseload control or generator failure.

#### **1.3 Shop Drawings**

- .1 Submit Shop Drawings in accordance with **Section 01300 – Submittals**.
- .2 Include:

## **AUTOMATIC LOAD TRANSFER EQUIPMENT**

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- .1 Make, model and type of control unit.
- .2 Single line diagram showing controls and relays.
- .3 Description of equipment operation including:
  - .1 Automatic starting and transfer to standby unit and back to normal power.
  - .2 Test control.
  - .3 Manual control.
  - .4 Baseload Controller.
  - .5 Automatic shutdown.

### **1.4 Operation and Maintenance Data**

- .1 Provide operation and maintenance data for automatic load transfer equipment for incorporation into manual specified in **Section 01730 – Operation Maintenance Manuals**.
- .2 Detailed instructions to permit effective operation, maintenance and repair.
- .3 Technical data:
  - .1 Schematic diagram of components, controls and relays
  - .2 Illustrated parts lists with parts catalogue numbers
  - .3 Certified copy of factory test results.

### **1.5 Source Quality Control**

- .1 Notify the Contract Administrator three (3) weeks in advance of factory acceptance testing.
- .2 Contract Administrator reserves the right to attend the factory testing.
- .3 Tests:
  - .1 Provide the Contract Administrator with a proposed test schedule for review. The Contract Administrator reserves the right to add additional tests at this time and during the testing.
  - .2 Demonstrate the proper relay protection settings have been programmed.
  - .3 Operate equipment both mechanically and electrically to ensure proper performance.
  - .4 Check selector switch, in all modes of operation Test, Auto, Manual, Engine Start and record results.

## **AUTOMATIC LOAD TRANSFER EQUIPMENT**

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- .5 Check voltage sensing and time delay relay settings.
- .6 Check:
  - .1 Automatic starting and transfer of load on failure of normal power. Failure either service transformer or both.
  - .2 Retransfer of load when normal power supply resumed
  - .3 Automatic shutdown
  - .4 In-phase monitor operation.
  - .5 Closed transition switching of utility supplies.
  - .6 Loadshedding scheme on generator power.
  - .7 Peak shaving operation.

## **2. PRODUCTS**

### **2.1 Materials**

- .1 Meters: to CAN3-C17.
- .2 Instrument transformers: to CAN3-C13.

### **2.2 Circuit Breaker Type Transfer Equipment**

- .1 Coordinate with MV Switchboard Manufacturer to ensure synchronizing monitoring across the required load transfer breakers is functional and controlled by the generator control system.
- .2 Electric breaker interlocks will prevent closing breakers when synchronization check fails.

### **2.3 Controls**

- .1 Selector switch four position "Test", "Auto", "Manual", "Engine start".
  - .1 Test position - Normal power failure simulated. Engine starts and transfer takes place. Return switch to "Auto" to stop engine.
  - .2 Auto position - Normal operation of transfer switch on failure of normal power; retransfers on return of normal voltage and shuts down engine.
  - .3 Manual position - Transfer switch may be operated by manual handle but transfer switch will not operate automatically and engine will not start. If the transfer switch is on manual operation mode, a red light should indicate a warning on the control panel

### AUTOMATIC LOAD TRANSFER EQUIPMENT

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and auxiliary contact to be provided for transferring this signal to Supervisory Control and Data Acquisition (SCADA) system.

- .4 Engine start position - Engine starts but unit will not transfer unless normal power supply fails. Switch must be returned to "Auto" to stop engine.
- .2 Control transformers: dry type with 120 V secondary to isolate control circuits from:
  - .1 Normal power supply
  - .2 Emergency power supply.
- .3 Relays: continuous duty, industrial control type, with wiping action contacts rated 10 A minimum:
  - .1 Voltage sensing, one per phase for normal power and on one phase only for emergency, solid state type, adjustable drop out and pick up, close differential, 2 V minimum under-voltage protection. Voltage sensing to initiate transfer of the load when normal power supply drops to 70% in any phase and pick up at 90% on all phases.
  - .2 Time delay, normal power to standby, adjustable solid state, five (5) seconds to one hundred and eighty (180) seconds.
  - .3 Time delay on engine starting to override momentary power outages or dips, adjustable solid state, one (1) to sixty (60) seconds delay.
  - .4 Time delay on retransfer from standby to normal power, adjustable twenty (20) seconds to thirty (30) minutes.
  - .5 Time delay for engine cool-off to permit standby set to run unloaded after retransfer to normal power, adjustable solid state, twenty (20) seconds intervals to ten (10) minutes.
  - .6 Time delay during transfer to stop transfer action in neutral position electrically to prevent fast transfer, adjustable, five (5) seconds intervals to one hundred and eighty (180) seconds.
  - .7 Frequency sensing, to prevent transfer from normal power until supply until frequency of standby unit reaches preset adjustable values.
- .4 Solid state electronic in-phase monitor.
- .5 Touch screen graphics display panel, refer to **Division 17** for Specifications
- .6 Programmable logic controller (PLC), refer to **Division 17** for Specifications

#### 2.4 Accessories

- .1 Test pushbutton (momentary contact) to simulate failure of normal power.

## **AUTOMATIC LOAD TRANSFER EQUIPMENT**

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### **2.5 Equipment Identification**

- .1 Provide equipment identification in accordance with **Section 16010 - Electrical General Requirements**.
- .2 Control panel:
  - .1 For selector switch and manual switch.
  - .2 For meters, indicating lights, minor controls.

### **3. EXECUTION**

#### **3.1 Installation**

- .1 Installation by others.
- .2 Provide installation assistance in accordance with **Section 01650 – Equipment Installation**.

#### **3.2 Field Quality Control**

- .1 Perform tests in accordance with **Division 1**.
- .2 Assist testing performed by the Installation Contractor
- .3 Energize transfer equipment from normal power supply.
- .4 Set selector switch in "Test" position to ensure proper standby start, running, transfer, retransfer. Return selector switch to "Auto" position to ensure standby shuts down.
- .5 Set selector switch in "Manual" position and check to ensure proper performance.
- .6 Set selector switch in "Engine start" position and check to ensure proper performance. Return switch to "Auto" to stop engine.
- .7 Set selector switch in "Auto" position and open normal power supply disconnect. Standby should start, come up to rated voltage and frequency, and then load should transfer to standby. Allow to operate for ten (10) minutes then close main power supply disconnect. Load should transfer back to normal power supply and standby should shutdown.
- .8 Repeat, at one (1) hour intervals, two (2) times, complete test with selector switch in each position, for each test.

#### **3.3 Sequence of Operation**

- .1 A detailed sequence of operation shall be submitted to the Contract Administrator with the Shop Drawing. The Contract Administrator will review and modify the sequence.

**AUTOMATIC LOAD TRANSFER EQUIPMENT**

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- .2 The normal operating procedure for the plant is to feed from both sets of transformers with the tie switch on the primary switchboard open:
  - .1 4.16 kV primary switchboard
    - .1 4.16 kV main breakers are in closed positions: BK-E100A, BK-E100B
    - .2 4.16 kV tie breaker is in open position: BK-E100C
    - .3 4.16 kV feeder breakers are in closed positions: BK-E101A, BK-E102A, BK-E103A, BK-E104A, BK-E101B, BK-E102B, BK-E103B, BK-E104B.
  - .2 4.16 kV generator switchboard
    - .1 4.16 kV breakers are in open positions: BK-E105A, BKE105B, BK-E200C, BK-E201A, BK201B
- .3 The plant can be operated from a single transformer with one main breaker open and the tie breaker closed.
  - .1 4.16 kV primary switchboard
    - .1 4.16 kV main breakers are in closed positions: BK-E100A(or BK-E100B)
    - .2 4.16 kV tie breaker is in open position: BK-E100C
    - .3 4.16 kV feeder breakers are in closed positions: BK-E101A, BK-E102A, BK-E103A, BK-E104A, BK-E101B, BK-E102B, BK-E103B, BK-E104B.
  - .2 4.16 kV generator switchboard
    - .1 4.16 kV breakers are in open positions: BK-E105A, BKE105B, BK-E200C, BK-E201A, BK201B
- .4 Automatic transition from dual utility supply to single utility supply at 4.16 kV switchboard.
  - .1 After receiving the 4.16 kV automatic transition signal from operator, the control system detects the status of main breakers BK-E100A & BK-E100B.
  - .2 If the breaker BK-E100A and BK-E100B are in closed position and the voltage and frequency ahead of BK-E100C nominal, synchronized closing BK-E100C. Trip breaker BK-E100A(or BKE-100B) upon confirming BK-E100C in closed position
  - .3 If the breaker BK-09A-200B is in closed position while BK-09A-200A in open position and the voltage and frequency ahead of BK-09A-200A nominal, synchronized closing BK-09A-200A. Trip breaker BK-09A-200B upon confirming BK-09A-200A in closed position

**AUTOMATIC LOAD TRANSFER EQUIPMENT**

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- .5 Automatic transition from single utility supply to single utility supply at 4.16 kV switchboard.
  - .1 After receiving the 4.16 kV automatic transition signal from operator, the control system detects the status of main breakers BK-E100A & BK-E100B.
  - .2 If the breaker BK-E100A is in closed position while BK-E100B in open position and the voltage and frequency ahead of BK-E100B nominal, synchronized closing BK-E100B. Trip breaker BK-E100A upon confirming BK-E100B in closed position.
  - .3 If the breaker BK-E100B is in closed position while BK-E100A in open position and the voltage and frequency ahead of BK-E100B nominal, synchronized closing BK-E100A. Trip breaker BK-E100B upon confirming BK-E100A in closed position.
- .6 Automatic transition from single utility supply to dual utility supply at 4.16 kV switchboard.
  - .1 After receiving the 4.16 kV automatic transition signal from operator, the control system detects the status of main breakers BK-E100A & BK-E100B.
  - .2 If the breaker BK-E100A is in closed position while BK-E100B in open position and the voltage and frequency ahead of BK-E100B nominal, synchronized closing BK-E100B. Trip breaker BK-E100C upon confirming BK-E100B in closed position.
  - .3 If the breaker BK-E100B is in closed position while BK-E100A in open position and the voltage and frequency ahead of BK-E100B nominal, synchronized closing BK-E100A. Trip breaker BK-E100C upon confirming BK-E100A in closed position.
- .7 Loss of utility power or voltages of one 4.16 kV bus below the dropout:
  - .1 When the voltage sensors on one 4.16 kV bus below the dropout, the control system proceeds to automatically transfer to a single utility supply.
- .8 Loss of utility power or voltages of both 4.16 kV buses below the dropout:

When the voltage sensors on one 4.16 kV bus below the dropout, the control system proceeds to start the emergency power system automatically.

  - .1 Trip the breakers BK-E100A and BK-E100B. Send a start signal to generator control system. Receiving the start signal, the generator control system will start all generator sets and monitor the starting process. When one generator reaches the rated voltage and frequency first, the generator control system will close the breaker of this generator and block the other generator's breaker from closing. The remaining generator's breaker shall synchronize with the first generator's breaker after it reaches the rated voltage and frequency.
  - .2 When the generator sets are running stably and properly, the breakers BK-E100A and BK-E100B in open positions as well, close the breaker BK-104A and the generator sets begin to carry the loads on bus SG-09A-200A.



### **AUTOMATIC LOAD TRANSFER EQUIPMENT**

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- .3 If the tie breaker BK-E100C in open position, close BK-E100C. The generator sets carry all the loads on bus SWGR-E100A and bus SWGR-E100B.

- .9 Utility power back to normal:

When the voltage sensor installed on the PT ahead of the breaker BK-E100A (or BK-E100B) detecting the utility power supply to be normal, the breakers BK-E100A and BK-E100B in open position, and no fault and alarm signal presenting and protective relays being reset, the breaker BK-E104A in closed position and emergency power feeding loads, the control system proceeds to the steps as follows.

- .1 Check the positions of breakers BK-E100C if in open position, send close signal.
- .2 When the voltage and frequency ahead of BK-E100A and BK-E100B nominal, send a synchronizing close signal to the breaker BK-E100A and blocking signal to the breaker BK-E100B from close. After the breaker BK-E100A closed, soft unload the generators and trip the breaker BK-E104A. Stop generators after cool down.
- .3 When the breaker BK-E101A in closed position and the voltage and frequency ahead of BK-E100B nominal, tie breaker BK-E100C in closed position as well, send a synchronizing close signal to the breaker BK-E100B. After the breaker BK-E100B closed, trip the breaker BK-E100C.

- .10 Load Shedding:

- .1 When the generators are running either in baseload controller operation or power failure mode if the load exceeds generator capacity trip 600 V feeder breakers to reduce the load before generator failure.
- .2 The sequence or priority of feeders to trip shall be operator adjustable from the touch screen graphics display panel.
- .3 Allow for programming of twenty one (21) 600 V feeder breakers supplied by others.

### **3.4 Training**

- .1 Provide demonstration and training in accordance with **Division 1**.

**END OF SECTION**

## **STORAGE BATTERIES AND RACKS**

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### **1. GENERAL**

#### **1.1 References**

- .1 CAN3-Z299-3, Quality Assurance Program - Category 3.
- .2 CAN/CSA-G40.20, General Requirements for Rolled or Welded Structural Quality Steel.
- .3 American National Standards Institute/Underwriter's Laboratories (ANSI/UL) 94, Tests for Flammability of Plastic Materials for Parts in Devices and Appliances.

#### **1.2 Shop Drawings and Product Data**

- .1 Submit Shop Drawings and product data in accordance with **Section 01300 – Submittals**. Include the following:
  - .2 Dimensioned sketch showing battery rack, individual battery cells, recommended aisle space, headroom, assembly and anchoring of rack.
  - .3 Shipping weights.
  - .4 Individual battery cells, type, size, A.h capacity at 8 h discharge rate, electrolyte, materials for container, cover, separators, retainers, posts and inter-cell connectors.
  - .5 Specific gravity at full charge and 25°C.
  - .6 Cell charge and discharge curves of voltage, current, time and capacity.
  - .7 Derating factor for temperature range (-10°C to -30°C).
  - .8 Maximum short circuit current.
  - .9 Maximum charging current recommended for fully discharged condition.
  - .10 Full charge voltage per cell.
  - .11 Fully discharged voltage per cell.
  - .12 Hydrogen generation and ventilation requirements.

#### **1.3 Operation and Maintenance Data**

- .1 Provide operation and maintenance (O&M) data for storage batteries and racks for incorporation into manual specified in **Section 01730 – Operation and Maintenance Manuals**.
- .2 O&M instructions concerning design elements, construction features, component functions and maintenance requirements to permit effective operation, maintenance, and repair.

## **STORAGE BATTERIES AND RACKS**

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- .3 Installation details of battery rack, individual cells, inter-cell connectors.
- .4 Replacement instructions for individual cells.
- .5 Electrolyte handling.
- .6 Parts lists with catalogue numbers, and names and addresses of suppliers.
- .7 Factory test records.

### **1.4 Source Quality Control**

- .1 To CAN3-Z299.3.
- .2 Complete battery factory tested in presence of the Contract Administrator.
- .3 Install dc indicating voltmeter and ammeter.
- .4 Charge battery to ensure cells fully charged. When voltage reaches steady state, record: ambient temperature, temperature of each cell, voltage of each cell, voltage of battery, specific gravity of each cell (lead acid battery only).
- .5 Discharge battery by applying load for one hundred and twenty (120) minutes, and record at 85%, 90%, 95%, and 100% of rated discharge time: voltage of battery, load current, voltage of each cell, ambient temperature, battery temperature, specific gravity of few random cells (lead acid only).
- .6 At completion of discharge test, recharge battery at maximum specified rate, and record at ten (10) minute intervals: battery voltage, charging current.
- .7 At start and finish of charging cycle record ambient and battery temperatures and specific gravity of each cell (lead acid only).
- .8 Submit copy of test results to the Contract Administrator prior to delivery.

## **2. PRODUCTS**

### **2.1 Materials**

- .1 Steel for battery racks: to CAN/CSA-G40.20.

### **2.2 Battery Characteristics**

- .1 Nominal battery voltage, full charge, 24 V.
- .2 Designed to supply load current sufficient to crank engine five (5) times consecutively.
- .3 Minimum end voltage: 1.75 V per cell after discharge at rated load for period specified.

## **STORAGE BATTERIES AND RACKS**

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- .4 Capable of being recharged in period of eight (8) hours to not less than 95% full charge after supplying rated load for period specified, with no harmful effects on battery, including leaking or foaming of electrolyte.
- .5 Battery to deliver specified output at 15°C, in ambient temperature from 15°C to 35°C.

### **2.3 Lead Acid Batteries**

- .1 Type Sealed.
- .2 Electrolyte: solution of sulphuric acid, specific gravity 1.215 at 25°C.
- .3 Cell containers: transparent plastic or polycarbonate, fire retardant.
- .4 Electrolyte level lines: high and low on container surfaces.
- .5 Cover: one (1) piece molded plastic, flame retardant to ANSI/UL 94.
- .6 Plate retainers: fibreglass or synthetic fibre.
- .7 Plate separators: porous rubber or fibreglass.
- .8 Vents: plastic screw flame arrester type or porous aluminum oxide.
- .9 Posts: bolted type with two (2) lead covered brass nuts and bolts per cell.
- .10 Inter-cell connectors: lead plated copper, bolted to battery posts. Bolt holes slightly oversize to facilitate cell replacement. Connectors, bolts and nuts: corrosion resistant.
- .11 Cells: of identical construction and from same production run.
- .12 Batteries: in clean state with no evidence of electrolyte on outside of cell containers.

### **2.4 Accessories**

- .1 Accessories: thermometer, plastic topping-up bottle, 1000 cc, hydrometer, torque wrenches for connector bolts and nuts, self-adhesive numbers for cell identification, lifting straps, no-oxide grease, hydrometer holder with wall mount brackets, heat sensing tape.
- .2 Two (2) spare intercell connectors, nuts and bolts.
- .3 Two (2) spare inter-tier connectors, nuts and bolts.

### **2.5 Battery Rack**

- .1 Bottom tier minimum 120 mm above floor, top of battery cells on highest tier not more than 2 m above floor.
- .2 Frames: angle iron with welded joints ground smooth.

**STORAGE BATTERIES AND RACKS**

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- .3 Rails: steel channels, bolted to frames.
- .4 Rubber or Plastic strips to insulate rails from cells.
- .5 Insulated from ground and floor.
- .6 Primed and epoxy painted to prevent corrosion.
- .7 Corrosion resistant bolts and hardware.
- .8 Configuration permitting any one cell to be removed without removing any other cell.

**3. EXECUTION**

**3.1 Installation**

- .1 Installation by others.

**END OF SECTION**

## **BATTERY CHARGERS**

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### **1. GENERAL**

#### **1.1 Shop Drawings and Product Data**

- .1 Submit Shop Drawings in accordance with **Section 01300 - Submittals**.
- .2 Outline sketch with dimensions showing arrangement of cubicle, components, meters, and controls.
- .3 Shipping weight.
- .4 Schematic diagram showing components.
- .5 Charger Data: Type and capacity, battery charging sequence, current-time data for protective devices, estimated noise level, metering, alarms, controls, and efficiency.

#### **1.2 Operation and Maintenance Data**

- .1 Provide operation and maintenance (O&M) data for battery charger for incorporation into manual specified in **Section 01730 – Operating and Maintenance Manuals**.
- .2 Include O&M instructions covering design elements, construction features, component functions and maintenance requirements to permit effective operation, maintenance, and repair.
- .3 Copy of approved Shop Drawings.
- .4 Technical description of components.
- .5 Parts lists with catalogue numbers and names and addresses of suppliers.

### **2. PRODUCTS**

#### **2.1 Charger Characteristics**

- .1 Input: 208 VAC, 3 phase, 4 wire, grounded neutral, 60 Hz.
- .2 Output: 40 ADC at 24 VDC, ripple voltage less than 2%.

#### **2.2 Charger Performance**

- .1 Automatically maintain battery in fully charged state while mains power available. Maintain DC float voltage within plus or minus 1% of setting, no load to full load, during mains voltage variations of plus 10% to minus 15% and frequency variations of plus or minus 5%.
- .2 Equalize charging rate such that after battery has provided full power output for specified duration, charger returns batter to 95% of fully charged state in eight (8) hours.

## BATTERY CHARGERS

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- .3 Automatically equalize charging circuit to initiate charging of battery for twenty four (24) hours after discharge of 5% of ampere-hour battery rating.
- .4 Manually initiated equalize charging feature with automatic timer adjustable from zero (0) to twenty four (24) hours, to return unit to float charge.
- .5 Manual adjustment of float charge voltage with range plus or minus 5%.
- .6 Manual adjustment of equalizing charge voltage.
- .7 Automatic current limiting adjustable between 80 and 120% of normal voltage rating.
- .8 Audible noise level not to exceed 65 dBA at 1.5 m.

### 2.3 Accessories

- .1 DC digital Voltmeter: Switchboard type, accuracy plus or minus 2% of full scale, to measure rectifier output voltage.
- .2 DC digital Ammeter: Switchboard type, accuracy plus or minus 2% of full scale, to measure rectifier output current.
- .3 Relay and alarm for AC power failure with time delay to prevent alarm during short power outages.
- .4 Low DC voltage alarm to indicate over discharge.
- .5 High DC voltage alarm and high dc voltage automatic shutdown.
- .6 No-charge alarm to indicate charger has no DC output.
- .7 Ground detector relay and alarm.
- .8 Equalizing timer: Automatic reset type for unattended stations, twenty eight (28) day period.
- .9 Filter to reduce ripple voltage in rectifier output from 2% to 100 mV.
- .10 LEDs mounted on front to indicate: failure ac power, low DC voltage, high DC voltage, no rectifier output.
- .11 Alarms: Audible alarm when any LED indicates trouble. Silence pushbutton not to extinguish trouble light.
- .12 Common LED test switch and one (1) common Form C alarm contact.
- .13 Cables and clips

## **BATTERY CHARGERS**

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### **2.4 Enclosure**

- .1 Dead front free standing sheet steel, minimum 2.5 mm thick CSA Enclosure 1.
- .2 Access from front.
- .3 Convection ventilated.
- .4 Meters, indicating lamps and controls group mounted on front panel.
- .5 Provision for handling by forklift or sling.
- .6 Apply finish in accordance with **Section 16010 - Electrical General Requirements**.

### **2.5 Equipment Identification**

- .1 Provide equipment identification in accordance with **Section 16010 - Electrical General Requirements**.
- .2 For major components such as input breakers, output breaker:
- .3 For mode lights alarms, meters.

## **3. EXECUTION**

### **3.1 Installation**

- .1 Installation by others

**END OF SECTION**



## INSTRUMENTATION AND CONTROL GENERAL REQUIREMENTS

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### 1. GENERAL

#### 1.1 Requirements of Work

- .1 Supply, and provide warranty for a complete and fully documented instrumentation and control (I&C) system in accordance with the Specifications. The I&C system will form a subsystem of the overall plant control system and contains Manufacture's component subsystems specified in this and other sections of the specification.
- .2 Component subsystems of the I&C system will include, but are not limited to, the following:
  - .1 Primary elements and transmitters.
  - .2 Final control elements.
  - .3 I&C field devices.
  - .4 I&C junction boxes, local control panels, and marshalling panels.
  - .5 Specialized Instrumentation cables.
  - .6 Instrument cables and associated conduit and/or fasteners where the instrument is connected to a control panel or other instrument located within the same equipment package skid.
  - .7 Instrumentation power supplies.
- .3 Ensure the correct functionality of any equipment supplied under other divisions of this Specification.
- .4 Documentation provided by the Contractor shall include as a minimum:
  - .1 Equipment descriptive data.
  - .2 Equipment installation instructions, service manuals, operation and maintenance (O&M) manuals, bills of materials, and recommended spare parts lists.
  - .3 Schematics and interconnection wiring diagrams sealed by a Professional Engineer registered in the Province of Manitoba.
  - .4 Records of conductor identification, field terminals, cable lists and all other information necessary for the installation of the equipment.
  - .5 I&C panel Shop Drawings, face layouts, schematics, and point-to-point wiring diagrams sealed by a Professional Engineer registered in the Province of Manitoba.
  - .6 For the programmable logic controller (PLC) based control system, the Contractor shall provide detailed documentation of the system hardware and software. Minimum

## INSTRUMENTATION AND CONTROL GENERAL REQUIREMENTS

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software documentation shall include a detailed operating description, flow charts that describe the functionality of the PLC program, a memory map, and the PLC program and documentation. This information shall be submitted at the Shop Drawing stage.

- .5 Documentation provided by the Contractor shall be formatted as follows:
  - .1 *Piping and Instrumentation Diagram (P&IDs)* – Depict the general intent of the control systems and are to be used as the governing document for the scope of Work. Coordinate the implementation of equipment tag name and numbering conventions for all instrumentation with the Contract Administrator
  - .2 *Instrument Index* – A sorted index of the detailed information for the devices shown on the P&IDs. The index lists the appropriate support documentation for the devices' supply and installation. The instrument index is the controlling document for the supply of materials.
  - .3 *Input/Output (I/O) Index* – A sorted index of the control system I/O points shown on the P&IDs, giving the supporting documentation as per the instrument index.
  - .4 *Instrument Specification Sheets* – Detail the relevant data for the supply of devices.
  - .5 *Instrument Loop Diagram (ILD)* – Shows typical interconnections and hook-up of devices. The Contractor is to produce an ILD for each device and record all relevant information on each sheet for submission at the completion of the Work. Fill in all terminal and wiring numbers etc. from the Shop Drawings as they become available. A set of 'B' size (11" x 17") ACAD drawings and associated files will be made available to the successful bidder. Where an ILD is not shown for wiring of simple devices provide a legible sketch for as-built information.
  - .6 *Location Drawings* – Indicate in plan and/or elevation views where the instrument elements are physically located. These drawings are provided to assist the Installer in estimating the amount of cable and ducting required.
  - .7 *Standard Details* – Provide a reference for installation, operation, and other instructions pertinent to a particular device.
  - .8 *Detailed Specification* - lists qualifications, quality of materials and workmanship, and supplementary information.

**INSTRUMENTATION AND CONTROL GENERAL REQUIREMENTS**

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.6 References

- .1 This Specification contains references to the following documents. They are a part of this Section as specified and modified. In case of conflict between the requirements of this Section and those of the listed documents, the requirements of this Section prevail.

| <b><u>Reference</u></b>    | <b><u>Title</u></b>   |
|----------------------------|---|
| <b>API RP550-86</b>        | Manual on Installation of Refinery Instruments and Control Systems, Part I – Process Instrumentation and Control Section 1 through 13 |
| <b>ASME Section VII-89</b> | Rules for Construction of Pressure Vessels  |
| <b>ASTM B68-86</b>         | Seamless Copper Tube  |
| <b>ASTM D883-89</b>        | Terms Relating to Plastics  |
| <b>IEEE 100-88</b>         | Dictionary of Electrical and Electronic Terms   |
| <b>ISA RP7.1-56</b>        | Pneumatic Control circuit Pressure Test   |
| <b>ISA RP12.6-87</b>       | Installation of Intrinsically Safe Systems for Hazardous (Classified) Locations   |
| <b>ISA S5.4-76</b>         | Instrument Loop Diagrams  |
| <b>ISA S18.1-79</b>        | Annunciator Sequences and Specifications  |
| <b>ISA S51.1-79</b>        | Process Instrumentation Terminology   |
| <b>NEMA 250-85</b>         | Enclosures for Industrial Controls and Systems  |
| <b>NEMA ICS 1-88</b>       | General Standards for Industrial Controls and Systems   |
| <b>NEMA ICS 2-88</b>       | Industrial Control Devices, Controllers, and Assemblies   |
| <b>NFPA 70-90</b>          | National Electrical Code (NEC)  |
| <b>SAMA PMC 17-10-63</b>   | Bushings and Wells for Temperature Sensing Elements   |
| <b>UBC-88</b>              | Uniform Building Code   |
| <b>UL 1012-89</b>          | Power Supplies  |
| <b>UL 94-80</b>            | Tests for Flammability of Plastic Materials for Parts in Devices and Appliances   |
| <b>Weik, Martin H.</b>     | Communications Standard Dictionary, Van Nostrand Reinhold Co., 1983   |

## INSTRUMENTATION AND CONTROL GENERAL REQUIREMENTS

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- .3 Related Work
  - .1 Mechanical: Division 15
  - .2 Electrical: Division 16
- .4 Codes, Rules, Permits and Fees
  - .1 Comply with all laws, ordinances, rules, regulations, codes, and orders of all authorities having jurisdiction relating to this Work.
  - .2 Comply with all rules of the Electrical Safety Act of the Province, Canadian Standards Association (CSA) Standards, Underwriters Laboratories of Canada (ULC) and the applicable building codes, whether specifically shown on Drawings or not.
  - .3 Give all required notices, submit Drawings, obtain all permits, licenses and certificates and pay all fees required for this Work.
- .5 Standards of Workmanship
  - .1 Execute all Work in a manner which will result in the completed installation presenting an acceptable appearance.
  - .2 Install products in accordance with the recommendations and ratings of the Manufacturers.
  - .3 Supply and execute installation of all instrumentation control tubing in accordance with **Division 17**.
- .6 Contract Drawings and Specifications
  - .1 Refer to **Division 1**.
  - .2 Supply all items and accessories specified by the Drawings or the Specification in the quality and quantity required. Perform all operations as designated by the Specification according to the methods prescribed, complete with all necessary labour and incidentals.
  - .3 Treat any item or subject omitted from this Division's Specifications or Drawings, but which is mentioned or reasonably specified in other Divisions' Specifications or Drawings and pertains to the I&C system, as being integral to the overall system. Provide such specified items or subjects.
  - .4 Provide all minor items and Work not shown or specified but which are reasonably necessary to complete the Work.
  - .5 The responsibility to determine which Division provides various products and Work rests with the Contractor. Additional compensation will not be considered because of differences in interpretation of Specifications.

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**INSTRUMENTATION AND CONTROL GENERAL REQUIREMENTS**

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**1.2 Equipment**

- .1 Perform a final examination prior to delivery to Site to ensure that:
  - .1 All I&C components supplied for this project under this Section of the Specification comply with the requirements stated in the instrument specification sheets.
  - .2 All I&C components supplied under other Sections of this Specification, to be connected to I&C components supplied under this Section of the Specification, comply with the requirements stated in the Contract documents.
  - .3 All I&C components conform to the specifications. Any delays in construction resulting from the delivery to Site of non-conforming I&C components shall be borne by the Contractor.
  - .4 Ensure that covers where required are properly installed on all equipment. Provide all covers, padding, guards, etc. as required to guard any equipment against damage.

**1.3 Site**

- .1 Classification of plant areas:
  - .1 Electrical and generator room: Ordinary Area.

**1.4 Documentation**

- .1 Submittals
  - .1 Submit Shop Drawings for all products supplied by this Division. Submit Shop Drawings for review prior to purchase of any products or equipment and sufficiently in advance to allow ample time for checking.
  - .2 Contractor to review, modify, and approve the Shop Drawings prior to submitting Shop Drawings to the Contract Administrator for review. Contractor approval of a Shop Drawing indicates the following:
    - .1 The Drawing has been checked by the person making the approval.
    - .2 The equipment or material complies in all respects with the requirements of the Specifications and Drawings.
    - .3 The quantities indicated are correct.
    - .4 The physical dimensions of the components are such that they can be installed without interference with the building structure or other equipment, and after installation, there are sufficient clearances on all sides for maintenance, servicing, and operation of the equipment.

## INSTRUMENTATION AND CONTROL GENERAL REQUIREMENTS

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- .5 The points of attachment are clearly indicated, i.e. TOP, BOTTOM, SIDE, etc.
  - .6 The arrangement and location are properly oriented.
  - .7 The product is suitable for its intended use.
  - .8 The submission consists of sufficient information to adequately convey the scope of supply and the specific product to be supplied is highlighted.
  - .9 The submission contains sufficient information to install the equipment or systems.
- .3 Stamp and sign the Shop Drawing to show approval, indicating the above has been complied with. If Contractor revisions are too extensive, return the submission to the Manufacturer for revision, then repeat the Shop Drawing approval process before submitting them to the Contract Administrator.
  - .4 Refer to **Division 1** for further information on Shop Drawing submittals.
- .2 O&M Manuals
    - .1 Refer to **Division 1** for general O&M manual submittal information.
    - .2 In addition to the requirements specified in **Division 1**, provide the following information:
      - .1 Table of Contents – Arrange contents sequentially by systems under Section numbers. Label tabs of dividers between each to match Section numbers in the Table of Contents.
      - .2 Systems Descriptions – A brief synopsis of each system typed and inserted at the beginning of each Section. Include sketches and diagrams where appropriate.
      - .3 O&M instructions of all equipment and controls – These operating instructions need not be Manufacturer’s data but may be typewritten instructions in simple language to guide the City in the proper O&M of this installation.
      - .4 A copy of all wiring diagrams complete with wire coding.
      - .5 Include type and accuracy of instruments used.
      - .6 Set of final reviewed Shop Drawings.
      - .7 Provide a tabulated list of all consumables utilized (fuses, lamps, etc.) indicating where used, type, rating and reorder details.

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**INSTRUMENTATION AND CONTROL GENERAL REQUIREMENTS**

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**2. PRODUCTS**

**2.1 General**

- .1 Refer to the requirements of **Division 1**.
- .2 Quality of Products
  - .1 All products provided to be CSA approved and ULC approved where applicable.
  - .2 If products specified are not CSA approved, obtain the approval of the relevant provincial regulatory authority. Pay all applicable charges levied and make all modifications required for approval.
  - .3 Refer to **Division 1** of this Specification for further information.
- .3 Uniformity of Manufacture
  - .1 Unless otherwise specifically called for in the Specification, uniformity of manufacture is to be maintained for similar products throughout the Work.
- .4 Product Finishes
  - .1 Contractor to indicate proposed finishes to be used for Contract Administrator's review.

**2.2 Instrumentation**

- .1 General
  - .1 Instruments shall be suitable for the environmental conditions in which they are to be installed.
  - .2 Determine where injurious conditions may be expected to occur and make proper provision to protect the instruments to ensure their proper and reliable operation.
  - .3 Provide power surge protection, heating cables, and devices to protect instruments, equipment, and lines from being functionally impaired or damaged by power surges or environmental conditions such as moisture or freezing.

**2.3 Identification**

- .1 Provide lamacoid nameplates with 6 mm black lettering on white background. Identify the loop tag number (where applicable) and the device name, function, and instrument range or setpoint value on the nameplate.
- .2 Where it is not possible to attach a lamacoid nameplate to a field instrument component, provide the component with a stainless steel metal tag firmly wired to the device and identified with the loop tag number.

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## INSTRUMENTATION AND CONTROL GENERAL REQUIREMENTS

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- .3 Identify all wires where they terminate at the marshalling panels, junction boxes, control panels, and field devices with a heat shrink sleeve with machine printed labelling.
- .4 Clearly mark all panels, pull boxes, junction boxes, etc. to indicate the nature of service.
- .5 Provide neatly typed circuit directories for panel power distribution systems to indicate loops or devices powered by the circuit and the fuse size.
- .6 For direct current wiring use black for positive and white for negative.
- .7 For thermistor wiring to motors use red and blue coloured insulated wire.

### **3. EXECUTION**

#### **3.1 Coordination with other Divisions**

- .1 Examine the Drawings and Specifications of all Divisions and become fully familiar with the Work. Before commencing Work, obtain a ruling from the Contract Administrator on any conflicting issues between Divisions. No compensation will be made for any costs arising from conflict not identified before Work has commenced.
- .2 Layout the Work and equipment with due regard to architectural, structural, and mechanical features. Architectural and structural Drawings take precedence over electrical Drawings regarding locations of walls, doors, and equipment.

#### **3.2 Product Handling**

- .1 Remove advertising labels from all products that have such labels attached. Identification or CSA labels are not to be removed.
- .2 Remove dirt, rubbish, grease, etc. resulting from Work performed under this Section of the Contract from all surfaces.

#### **3.3 Separation of Services**

- .1 Maintain separation between the electrical wiring system, piping, ductwork and the instrumentation cables so that each system is isolated (except at approved connections to such systems) to prevent galvanic corrosion. In particular, contact between dissimilar metals, such as copper and aluminum, in damp or wet locations is unacceptable.
- .2 Classifications of Circuits
  - .1 The circuit categorization shall of first priority follow Canadian Electrical Code (CEC) with respect to separation for electrical safety and the following shall apply with respect to electro-magnetic compatibility:



**INSTRUMENTATION AND CONTROL GENERAL REQUIREMENTS**

|                |  |
|----------------|--|
| Very Noisy     | High voltage circuits and their associated grounding   |
|                | High current (>200A) LV circuits.  |
|                | Harmonic-rich LV circuits.   |
|                | DC circuits: un-suppressed or above 50V.   |
| Noisy          | Low current class two (2) circuits.  |
|                | Medium power pulsed or radio frequency circuits.   |
| Indifferent    | ELV digital status circuits.   |
|                | Intrinsically safe circuits.   |
|                | Telecommunications circuits.   |
|                | Fire alarm and emergency lighting circuits (note that some fire alarm circuits may fall into the category of signal circuits). |
|                | Any other emergency, shutdown, or high integrity circuit (e.g. toxic gas alarm).   |
| Sensitive      | Analogue signal circuits.  |
|                | Data communication circuits.   |
| Very Sensitive | Low level voltage and current signals (e.g. from instrument sensors).  |

**.3 Separation of Circuits**

- .1 This Section relates to the running of cables carrying differing types of circuits in close proximity to one another and to other services. Sensitive circuits shall normally be run in overall shielded cable. Very sensitive circuits shall normally be run in individually twisted pair shielded cable.
- .2 For cables sharing the same support/containment system, the following shall provide guidance to minimize extraneous interference.

| <b>Segregation between circuits</b> | <b>Very Noisy</b>                | <b>Noisy</b>                     | <b>Indifferent</b>           | <b>Sensitive</b> | <b>Very Sensitive</b> |
|-------------------------------------|----------------------------------|----------------------------------|------------------------------|------------------|-----------------------|
| Very Noisy                          | Thermal grouping as per CE Code. | 150 mm                           | 300 mm                       | 300 mm           | 300 mm                |
| Noisy                               | 150 mm                           | Thermal grouping as per CE Code. | 150 mm                       | 150 mm           | 150 mm                |
| Indifferent                         | 300 mm                           | 150 mm                           | Separation of circuit types. | 100 mm           | 100 mm                |
| Sensitive                           | 300 mm                           | 150 mm                           | 100 mm                       | Touching         | 50 mm                 |
| Very Sensitive                      | 300 mm                           | 150 mm                           | 100 mm                       | 50 mm            | Touching              |

**3.4 Wire and Cable**

- .1 Refer to **Section 17124 – Instrumentation Cable.**

## **INSTRUMENTATION AND CONTROL GENERAL REQUIREMENTS**

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### **3.5 Equipment Connections**

- .1 Prior to the connection of signal wiring to process control and instrumentation devices, check the device voltage rating and polarity for compatibility with the corresponding loop and/or schematic diagram. Where device and circuit characteristics are found to be incompatible, the connections are not to be made. Report the condition immediately to the Contract Administrator.
- .2 All control wiring diagrams illustrate typical control circuits applicable to the type of equipment specified. Control circuits may vary with different Manufacturers of equipment. Verify all control circuits with the Manufacturers of the equipment and make any corrections to the control wiring diagrams that may be required.
- .3 Provide power disconnect terminals in marshalling panels for all devices and PLC I/Os sourced from the panel. Provide local power disconnect switches for all 120 VAC power instruments. Mount adjacent the instrument.

### **3.6 Access Panels**

- .1 Provide access panels where I&C system junction boxes are concealed. Panels to be of adequate size for servicing of the concealed junction box and complete with necessary frames and hinged doors held closed with captive fasteners.

### **3.7 Tagging Standards for Devices and Wiring**

- .1 Tag all devices, wires, and I/O using the assigned loop, equipment, or device tag name. Where tag naming and numbering is not defined the Contract Administrator will provide naming and numbering that is consistent with the plant naming conventions.

### **3.8 Testing of Instrumentation Loops**

- .1 After all devices within a loop have been connected, check the loop for correct functioning and interaction with other loops, where applicable. Provide written notice to the Contract Administrator when the loops are going to be tested so that the tests may be witnessed at the Contract Administrator's discretion.
- .2 Check the operation of final control elements such as solenoid valves, actuators, etc. by manual control before checking with automatic control.
- .3 Check and simulate all alarms and shutdown functions.
- .4 Verify the status of all points connected or accessible to the plant control and monitoring system.
- .5 Where applicable, test all tubing for leaks in compliance with ISA RP7.1. Isolate all instruments when tubing is being tested to protect against over pressure.

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**INSTRUMENTATION AND CONTROL GENERAL REQUIREMENTS**

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- .6 Perform tests and record results on the test data forms that are included in this Section. Develop additional and/or more detailed test forms as necessary to suit more complex instrumentation.
- .7 Sign and date all test reports. Submit the test reports to the Contract Administrator within five (5) working days of testing.

**3.9 Calibration**

- .1 Instruments to be factory pre-calibrated. Provide a printed record of the factory calibration parameters for “smart” devices.
- .2 Prior to calibration, completely program all “smart” transmitters including entries of the appropriate range and tag number. Provide a printed record of smart device serial numbers against their assigned tag number.
- .3 Instruments to be set up and calibrated by an accredited instrument technician working under the approval of the instrument Manufacturer.
- .4 Calibrate all instruments to an accuracy of ½ of 1% of full range, or to the Manufacturer’s state accuracy of the instrument whenever an accuracy of ½ of 1% is not achievable.
- .5 For each instrument supplied as part of an equipment skid, perform the following applicable calibration prior to instrument installation:
  - .1 Calibrate all inline flow meters by a draw-down test.
  - .2 Calibrate all density meters by lab samples.
  - .3 Calibrate all vacuum and pressure instruments by manometer or accurate test instrument and hand test pump.
  - .4 Calibrate gas detectors using standard gas sample.
  - .5 Calibrate temperature instruments against a standard lab thermometer.

**3.10 Test Forms**

| <u>Form No.</u> | <u>Title</u>            |
|-----------------|-------------------------|
| .1 ITR          | Instrument Test Report. |
| .2 LCR          | Loop Check Report.      |

**INSTRUMENTATION AND CONTROL GENERAL REQUIREMENTS**

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**INSTRUMENT TEST REPORT**

SYSTEM: \_\_\_\_\_  
 SERVICE: \_\_\_\_\_ TAG NO.: \_\_\_\_\_  
 LOCATION: \_\_\_\_\_  
 MAKE: \_\_\_\_\_ MODEL: \_\_\_\_\_  
 SERIAL NO.: \_\_\_\_\_ CSA: \_\_\_\_\_  
 ELEMENT: \_\_\_\_\_ RANGE: \_\_\_\_\_  
 DESIGN SETTING/RANGE: \_\_\_\_\_ CONTACT TO: \_\_\_\_\_ ON: \_\_\_\_\_  
 SIGNAL IN: \_\_\_\_\_ OUT: \_\_\_\_\_ ASSOCIATED INSTRUMENT: \_\_\_\_\_  
 INSTRUMENT CONDITION: \_\_\_\_\_ CONFORM TO SPEC: \_\_\_\_\_  
 PROJECT NO: \_\_\_\_\_ DATA SHEET: \_\_\_\_\_

|              | TEST 1 |      |        |      | TEST 2 |      |        |      |
|--------------|--------|------|--------|------|--------|------|--------|------|
| TEST METHOD  |        |      |        |      |        |      |        |      |
|              | INPUT  |      | OUTPUT |      | INPUT  |      | OUTPUT |      |
| PROCESS      | INC.   | DEC. | INC.   | DEC. | INC.   | DEC. | INC.   | DEC. |
| TEST POINT 1 |        |      |        |      |        |      |        |      |
| TEST POINT 2 |        |      |        |      |        |      |        |      |
| TEST POINT 3 |        |      |        |      |        |      |        |      |
| TEST POINT 4 |        |      |        |      |        |      |        |      |
| TEST POINT 5 |        |      |        |      |        |      |        |      |
| COMMENTS     |        |      |        |      |        |      |        |      |
|              |        |      |        |      |        |      |        |      |
|              |        |      |        |      |        |      |        |      |
| GRAPHS       |        |      |        |      |        |      |        |      |
|              |        |      |        |      |        |      |        |      |

TESTED BY: \_\_\_\_\_ CHECKED BY: \_\_\_\_\_

DATE: \_\_\_\_\_ DATE: \_\_\_\_\_

**INSTRUMENTATION AND CONTROL GENERAL REQUIREMENTS**

**LOOP CHECK REPORT**

- CHECKED OUT OK  
 NOT APPLICABLE  
 FURTHER ACTION REQUIRED

|   | INSTRUMENT TAG NO. |  |  |  |  |  |  |  |
|---|--------------------|--|--|--|--|--|--|--|
| LOOP NO. _____<br>SHEET NO. _____<br>P & I DWG. NO. _____ |                    |  |  |  |  |  |  |  |
| <b>INSTALLATION COMPLETE</b>                              |                    |  |  |  |  |  |  |  |
| Primary Element.  |                    |  |  |  |  |  |  |  |
| Impulse Lines.  |                    |  |  |  |  |  |  |  |
| Block and Drain Valves.                                   |                    |  |  |  |  |  |  |  |
| Air Supply/Filter/Reg.                                    |                    |  |  |  |  |  |  |  |
| Wiring.   |                    |  |  |  |  |  |  |  |
| Tracing/Insulation/Housing.                               |                    |  |  |  |  |  |  |  |
| Mounting and Location.                                    |                    |  |  |  |  |  |  |  |
| PLC/SCADA I/O & Status.                                   |                    |  |  |  |  |  |  |  |
| <b>CALIBRATED</b>   |                    |  |  |  |  |  |  |  |
| Impulse Lines Press. Tested.                              |                    |  |  |  |  |  |  |  |
| <b>LOOP CHECKED</b>                                       |                    |  |  |  |  |  |  |  |
| Element to Receiver.                                      |                    |  |  |  |  |  |  |  |
| X Mtr. To Receiver.                                       |                    |  |  |  |  |  |  |  |
| X Mtr./Trans. to Receiver.                                |                    |  |  |  |  |  |  |  |
| X Mtr./Trans. to Switches.                                |                    |  |  |  |  |  |  |  |
| Switches to Annunciator.                                  |                    |  |  |  |  |  |  |  |
| Interlocking Circuit.                                     |                    |  |  |  |  |  |  |  |
| Controller to Valve.                                      |                    |  |  |  |  |  |  |  |
| Controller Action D or R.                                 |                    |  |  |  |  |  |  |  |

REMARKS:

**READY FOR START-UP**

Date: \_\_\_\_\_

Installed by: \_\_\_\_\_

Checked by: \_\_\_\_\_

**INSTRUMENTATION AND CONTROL GENERAL REQUIREMENTS**

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**3.11 Installation and Performance Testing**

- .1 Refer to the requirements of **Division 1** for additional requirements.
- .2 Commissioning of the I&C system to include but not be limited to the following:
  - .1 Verify installation of components, wiring connections, and piping connections.
  - .2 Verify instrument calibration and provide written report.
  - .3 Assist I&C equipment Installation Contractor's service personnel as required for complete system testing.
  - .4 Instruct plant personnel in correct method of operation of I&C equipment.
  - .5 Direct plant personnel at hand-over as to final adjustment of the system for correct operation of plant.
  - .6 Coordinate and cooperate with City staff and the Contract Administrator to commission the interface between the Water Treatment Plant supervisory control and data acquisition (SCADA) and the packaged PLC based control system.

**3.12 Training**

- .1 Provide training, described in detail in **Division 1**, as required by the plant's personnel to become fully competent in the proper operation and maintenance of all control devices, control valves, and ancillary instrumentation described under this Section of the Specification.
- .2 For the PLC based control system, the Contractor shall provide maintenance training that includes a review of the PLC program, system troubleshooting, and identification of programmed system variables such as set-points, alarms, and statuses.

**END OF SECTION**

## ENCLOSURES

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### 1. GENERAL

#### 1.1. References - General

- .1 Equipment, Products and Execution must meet all requirements detailed in **Section 17010 – Instrumentation and Control General Requirements.**

### 2. PRODUCTS

#### 2.1. General

- .1 Unless otherwise specified, provide outside finishes on all enclosures in American National Standards Institute (ANSI) 61 Grey as specified in **Division 11.**
- .2 The enclosures must be suitable for carrying the weight of the equipment mounted inside the panel and on the doors without any warpage.

#### 2.2. Enclosures

- .1 Provide Electrical and Electronic Manufacturer's Association of Canada (EEMAC) type 12 gasketed enclosures in Motor Control Centre (MCC) rooms and control rooms.
- .2 All enclosures for mounting outside of MCC rooms and control rooms to be EEMAC Type 4, watertight except where otherwise specified.
- .3 Provide EEMAC 7/3R enclosures for equipment in and around classified areas such as sumps.
- .4 Enclosures for certain equipment in corrosive atmospheres to be EEMAC 4X approved for the classification (e.g. chemical cleaning).
- .5 Enclosures for mounting field control indicator lamps and switches in unclassified areas to be Allen Bradley model 800T-xTZ die cast enclosures.
- .6 Enclosures for mounting field control indicator lamps and switches in Class 1 areas to be Allen Bradley model 800H-xHHX7 cast aluminum enclosures.

#### 2.3. Panel Enclosures

- .1 Fabricate panel enclosures from 11 gauge steel panels complete with necessary stiffening to form a rigid free-standing lineup. The structures must be suitable for carrying the weight of the equipment mounted inside the panel and on the doors. Provide removable top and bottom cable entry plates.
- .2 Provide panels with front access only. Doors shall be key lockable and fitted with 3 point heavy duty latching assemblies. Provide a continuous piano hinge and a pneumatic hold open device on each door.

## ENCLOSURES

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- .3 Finish the interior of the enclosure with white paint. Provide a switched fluorescent light fixture and 120 VAC duplex convenience receptacle inside the enclosure.

### 2.4. Marshaling and Control Panels

- .1 Supply, fabricate, checkout, layout, document and deliver to Site fully equipped and functional panels.
- .2 Supply all components contained on or within the panels fully wired under this Section of the Specification.
- .3 The selection of all accessories, materials and methods for fabrication not covered by this Specification, but which are necessary to complete the fabrication of the control panels, is the responsibility of the Contractor.
- .4 Fans and filters shall be supplied and installed to pressurize all control panels thus discouraging dust accumulation and providing air purging for temperature and corrosion control.

### 2.5. Wiring and Accessories

- .1 Provide wiring inside the panels according to the following specifications:
  - .1 Control wiring to be a minimum of #16 AWG tinned stranded copper; insulation rated at 600 V.
  - .2 Wiring for power distribution shall be a minimum of #14 AWG tinned stranded copper; insulation rated at 600 V.
  - .3 Refer to **Division 16** for cable routing requirements.
- .2 Tag each wire at both ends with a heat shrink sleeve that is machine printed. Allow approximately 20 mm of wire insulation between the tag and the bare wire.
- .3 Wiring systems with different voltage levels or types shall be suitably segregated within the panel, according to relevant electrical codes.
- .4 Run all wiring in enclosed plastic wire ways such as Panduit. Size all wire ways so that the total cross sectional area of the insulated wire and cable does not exceed 40% of the cross sectional area of the wire way.
- .5 Provide a minimum clearance of 50 mm between wire ways and any point of wire termination.
- .6 Terminate all wiring, incoming and outgoing, at terminal strips mounted inside the panels. Identify each terminal strip with a terminal strip number, defined as follows:



## ENCLOSURES

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- .1 Wire identification to use the connected field device tag name with the wire's corresponding end device terminal number appended to it.
- .2 Identify every joint and/or terminal of the above wire run with the same identifier.
- .3 For example, pressure transmitter PT-O100A located in the field has a 2 PR-TPSH cable connected to it. The cable runs through a junction box to a marshaling panel. The wire identifiers for the pair of wires would be PT-O100A all the way to the marshaling panel.
- .4 Identify spare wires by using the cable tag, terminal number and an “-SP” suffix.
- .5 Arrange wiring on terminal blocks such that all internal panel wiring terminates on the inboard side of the terminal blocks and all external wiring terminates on the outboard side.
- .7 Two sources of 120 VAC power will be supplied by others to each control panel: Uninterruptible Power Supply (UPS) power for critical loads and non-UPS power for non-critical loads. Provide separate critical and non-critical 120 VAC power distribution systems and a 24 VDC power distribution system in each panel. Provide a thermal magnetic circuit breaker on each main power circuit and a fused terminal block for each branched circuit off the main.
- .8 Provide disconnect type terminal blocks Weidmuller WTR 4 series to isolate field wiring that is powered sourced from the panel.
- .9 Provide sufficient terminals so that not more than two (2) wires are connected under the same terminal. Provide 20% spare terminal capacity at each terminal block assembly.
- .10 Terminals shall be Weidmuller W Series color coded as follows:
  - .1 Red = positive 24 VDC
  - .2 Black = 0 VDC common and analog signal plus
  - .3 White = analog signal common and VAC neutral
  - .4 Grey = 120 VAC
  - .5 Green = ground
  - .6 Yellow = shield
- .11 Provide nameplates for each device on or within the panels and enclosures. Nameplates shall be white lamacoid with black lettering, a minimum of 25 x 75 mm in size with up to three (3) lines of 3 mm lettering. Securely fasten nameplates in and situate them in a visible location.

## **ENCLOSURES**

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### **2.6. Panel Grounding**

- .1 Provide a ground system for the instrumentation circuits, isolated from the main power system ground to each marshaling panel.
- .2 Provide grounding lugs for each panel, suitable for termination of up to #2 AWG copper grounding conductor.
- .3 Provide in each marshaling panel an isolated grounding bus bar 6 x 25 x 600 mm, equipped with necessary lugs for accepting two #2 AWG grounding conductors.
- .4 Firmly bond all panel mounted devices on or within the panels to ground. Provide supplementary bonding conductors for back panels and doors. Attach a separate bonding conductor to all devices that are not firmly fastened to the panels with screws for such devices as case mounted instruments, meters, etc.

### **3. EXECUTION**

#### **3.1. References - General**

- .1 Refer To **Section 17010 – Instrumentation and Control General Requirements**, Part 3.

#### **3.2. Mounting Heights**

- .1 Unless otherwise specified or a conflict exists, mount all panels, starters and disconnects 2000 mm to top of cover.

**END OF SECTION**

## **INSTRUMENTATION CABLE**

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### **1. GENERAL**

#### **1.1 Product Data**

- .1 Submit product data in accordance with **Division 1** and **Division 16**.
- .2 Instrument cables shall be supplied and installed between all instruments and control panels that are located within a single packaged skid. Instrument cables between instruments and control (I&C) panels that are not located within the same skid will be supplied and installed by others.

#### **1.2 Related Work**

- .1 Refer to **Division 16**.

#### **1.3 Standards**

- .1 All wire and cable shall be Canadian Standards Association (CSA) approved.

### **2. PRODUCTS**

#### **2.1 Twisted Pair Shielded Cables (TPSH)**

- .1 TPSH shall be constructed as follows:
  - .1 Two (2) copper conductors, stranded, minimum #18 AWG, polyvinyl chloride (PVC) insulated, twisted in nominal intervals of 50 mm.
  - .2 Insulated for 600 V, 90°C.
  - .3 100% coverage aluminum foil or tape shield.
  - .4 Separate bare stranded copper drain wire, minimum #18 AWG.
  - .5 Overall flame retardant PVC jacket to CSA-C22.2.
  - .6 The entire cable assembly to be suitable for pulling in conduit or laying in cable tray.
  - .7 Shaw Type 1751-CSA or Belden equal.
- .2 Where multi-conductor TPSH cables are called for, each pair shall be individually shielded, continuous number coded, and the cable assembly shall have an overall shield and overall flame retardant PVC jacket.

## **INSTRUMENTATION CABLE**

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### **2.2 RTD and Multi Conductor Shielded Cable**

- .1 RTD cables shall be CSA approved and shall be constructed as follows:
  - .1 Three (3) or more copper conductors, stranded, minimum #18 AWG.
  - .2 PVC insulated for 600 V.
  - .3 100% coverage aluminum foil or tape shield.
  - .4 Separate bare stranded copper drain wire.
  - .5 Overall flame retardant PVC jacket to CAS-C22.2

### **2.3 Teck Cables**

- .1 As per **Division 16**.

### **2.4 Wire**

- .1 As per **Division 16**.

## **3. EXECUTION**

### **3.1 Analog Signals**

- .1 Use TPSH cable for all low level analog signals such as 4 to 20 mA, pulse type circuits 24 VDC and under, and other signals of a similar nature.
- .2 Use RTD cable for connections between RTDs and transmitters or PLC RTD inputs.

### **3.2 Digital Signals**

- .1 Use TPSH cable for all low level (24 V and below) input and output signals.

### **3.3 Instrument Power**

- .1 Use Teck cable or wire and conduit for power to instruments, for 120 V signals other than those mentioned above and as otherwise indicated on the Drawings. Use stranded wire and cable to supply power to instruments.

### **3.4 Installation**

- .1 Install instrumentation cables in conduit systems. Use a minimum of 300 mm length of liquid tight flexible conduit to connect the field sensors to the conduit.
- .2 At each end of the run leave sufficient cable length for termination.

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**INSTRUMENTATION CABLE**

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- .3 Do not make splices in any of the instrumentation cable runs.
- .4 Cable shields shall be terminated on insulated terminals and carried through to the extent of the cable.
- .5 Ground cable shields at one end only. Unless otherwise specified, ground the shields at the marshalling panel.

**3.5 Conductor Terminations**

- .1 All equipment supplied shall be equipped with terminal blocks to accept conductor connections.
- .2 Instrumentation conductors, where terminated at equipment terminals other than clamping type terminal blocks, shall be equipped with Burndy-YAE-2 or STA-KON, self-insulated, locking type terminators, sized as required to fit conductors and screw terminals.

**3.6 Testing**

- .1 Test all conductors for opens, shorts, or grounds. Resistance values shall not be less than those recommended by the cable Manufacturer.

**3.7 Identification**

- .1 Identify all instrumentation cables.
- .2 Identify each conductor with wire numbers using a machine printed Raychem TMS heat shrink wire marker or approved equal.

**END OF SECTION**

## **POWER SUPPLIES**

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### **1. GENERAL**

#### **1.1 References - General**

- .1 Refer to **Section 17010 – Instrumentation and Control General Requirements**.

### **2. PRODUCTS**

#### **2.1 Power Supply and Conditioning Equipment**

##### **.1 General**

- .1 Provide all DC power supplies as required for all instrument circuits. All circuits are to be powered from the marshalling panels. Power supplies to be Hammond, G.F.C. or approved equal, complete with an over-voltage protection module.
- .2 Provide redundant configurations for power supply equipment serving more than one (1) instrument loop, so that failure of a single unit will not disable all or any shared part of the instrumentation and communication system. Provide diode isolation for redundant direct current supply units, and ground the negative terminal of the power supply.
- .3 Power supplies and transmitters feeding circuits that run in non-armored cable in cable tray shall meet the requirements for Class 2 circuits as defined under **Section 16** of the Canadian Electrical Code (CEC) Part I.
- .4 Unless otherwise required, all DC power supplies to be rated 28 VDC, adjustable plus or minus 5%, and set to provide 26.4 V on the panel direct current bus. Size the power supply for two (2) times the connected load, minimum size is 2 amps.

#### **2.2 Noise Suppression**

- .1 Provide power conditioners in each panel to power AC instrumentation and control (I&C) loads. Power conditioners are Oneac Series CX.

#### **2.3 UPS Power Supply**

- .1 Two (2) sources of 120 VAC power will be supplied by others to each control panel: UPS power for critical loads and non-UPS power for non-critical loads.
- .2 Control and operator interface system hardware including but not limited to programmable logic controllers (PLCs), PLC I/O racks, PLC communication modules, Human Machine Interface (HMI) computers and industrial network switches shall be powered from the UPS.
- .3 Instrument power and associated DC power supplies shall be powered from the UPS.
- .4 Non-critical loads include control panel interior lights and receptacles.

**POWER SUPPLIES**

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- .5 Provide the total expected critical and non-critical loads fed from each control panel as a Shop Drawing submittal so that the external power sources and UPS can be properly sized.
- .6 Mount a lamacoid on the control panel stating that the panel has more than one (1) power source.

**3. EXECUTION**

**3.1 References - General**

- .1 Refer to **Section 17010 – Instrumentation and Control General Requirements**, Part 3.

**END OF SECTION**

## SWITCHES AND RELAYS

---

### 1. GENERAL

#### 1.1 References - General

- .1 Refer to **Section 17010 – Instrumentation and Control General Requirements.**

### 2. PRODUCTS

#### 2.1 General

- .1 Use normally closed contacts for alarm actuation. The contacts open to initiate the alarm.
- .2 Use normally open contacts to control equipment. The contacts close to start the equipment.
- .3 Contacts monitored by solid state equipment to be hermetically sealed and adequately rated for the connected load.
- .4 Contacts monitored by electro-magnetic devices such as mechanical relays to be rated National Electrical Manufacturers Association (NEMA) ICS 2, designation B300.
- .5 Provide double barriers between switch elements and process fluids such that failure of one (1) barrier will not permit process fluids into electrical enclosures.
- .6 Switch electrical enclosures to be rated Electrical and Electronic Manufacturer's Association of Canada (EEMAC) 4X, minimum.
- .7 120 VAC switches to have a 4A rating.

#### 2.2 Indicators, Pushbuttons, and Selector Switches

- .1 All control indicator lamps, pushbutton switches and selector switches in unclassified or non-corrosive areas to be Allen Bradley 800T or 800E series items or Cutler Hammer 10250T series.
- .2 All control indicator lamps, pushbutton switches, and selector switches in classified or corrosive (includes outdoors) areas to be Allen Bradley 800H series items or Cutler Hammer E34 series.
- .3 Enclosures are specified under **Section 17110 - Enclosures.**
- .4 All control indicator lamps shall be push-to-test type.

#### 2.3 Relays

- .1 The quality and type of relays shall be based on Omron types. Other acceptable manufacturers are Idec and Potter & Brumfield.



## SWITCHES AND RELAYS

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- .2 120 VAC relays to be Model LY 4 PDT, plug-in, complete with test button, operation indicator, and surge suppressor.
- .3 24 VDC relays to be Model MY 2 PDT plug-in, complete with test button, operation indicator, and surge suppressor diode.
- .4 Time delay relays for behind panel mounting to be Omron Model H3BA, 2 PDT, plug-in, and programmable for sixteen (16) time ranges and four (4) operation modes.
- .5 Time delay relays for flush panel mounting and operator accessible timing range modifications to be Omron Model H5BR, SPDT, screw terminals, programmable for five (5) timing ranges and eight (8) operation modes, complete with digital display, module for time setting and flexible protective cover.
- .6 Where the contact ratings of the relays listed are insufficient for the application, select an appropriate type from an approved Manufacturer with the same quantity of contacts as was originally specified.
- .7 Provide relay plug-in sockets for DIN mounting complete with stacked screw clamp terminals.

### 2.4 Process Switches

- .1 Standard of acceptance for instrumentation shall be as follows:
  - .1 Thermal Flow Switches: Ifm, Weber.
  - .2 Pressure Switches (Electronic): Ifm, United Electric.
  - .3 Pressure Switches (Conventional): Ashcroft, United Electric, Barksdale.
  - .4 Conductivity Level Switches: Endress & Hauser.
  - .5 Vibration Type Level Switches: Endress & Hauser.
  - .6 Float Switches: Flygt, Consolidated Electric, Warwick, Magnetrol.
  - .7 Capacitance Level Switches: Siemens, Endress & Hauser.
  - .8 Admittance Level Switches: Magnetrol, Bestobell.
  - .9 Temperature Switches: Ifm.

## 3. EXECUTION

### 3.1 References – General

- .1 Refer to **Section 17010 – Instrumentation and Control General Requirements.**

**END OF SECTION**

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**MISCELLANEOUS PANEL DEVICES**

---

**1. GENERAL**

**1.1 References - General**

- .1 Equipment, Products and Execution must meet all requirements detailed in **Section 17010 – Instrumentation and Control General Requirements**.

**2. PRODUCTS**

**2.1 Miscellaneous Panel Devices**

.1 Pilot Lights

- .1 Provide pilot lights of the transformer type for extended lamp life, oil tight, push to test, complete with appropriate colour lenses. Normal colours used are run = red, stop = green. Refer to **Division 16** for additional information

.2 Terminals

- .1 Provide strap screw type terminal blocks rated for 600 V.
- .2 Identify each terminal block within an enclosure with a unique machine printed terminal block number. Cabinet chassis grounding terminal blocks are to be identified by the electrical ground symbol.
- .3 Connections to screw terminals to be locking fork tongue insulated crimp type wire connectors.
- .4 Terminals to be Weidmuller or approved equal.
- .5 Provide a group of terminals for each of 120 VAC hot and neutral, 120 VAC Uninterruptible Power Supply (UPS) hot and neutral and 24 VDC positive and negative power. Distribution wiring to have a thermal magnetic circuit breaker upstream of all major blocks of loads, adequately sized to protect the connected load while not causing nuisance tripping.
- .6 Provide Weidmuller disconnect type terminal blocks for each load or loop powered from the marshalling panels.

.3 Nameplates

- .1 Refer to **Section 17010 – Instrumentation and Control General Requirements** for nameplate specification.

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**MISCELLANEOUS PANEL DEVICES**

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**2.2 Signal Current Isolator**

- .1 Isolators shall be installed to provide galvanic isolation of milli-ampere transmission signals from transmitters with inadequately isolated output circuits.
- .2 Isolator to be housed in a NEMA 250, Type 4/7 conduit body and derive its operating power from the signal input circuit.
- .3 Input and output signals shall be 4 to 20 mA, with an error not exceeding 0.1% of span. Input resistance will not exceed 550 ohms with an output load of 250 ohms.
- .4 Approved Manufacturers are Moore Industries, Weidmuller, or Phoenix.

**2.3 Intrinsic Safety Barriers and Relays**

- .1 Provide intrinsic safety barriers where required for two-wire transmitters of the active, isolating, loop powered type; MTL Type MT3042, Stahl 9005/01-252/100/00, Pepperl & Fuchs ZG series, or approved equal.
- .2 Provide dual type intrinsic safety barriers for process switches; MTL 787, Panalarm 201-BR2.
- .3 Intrinsic safety relays to be Gems or Warrick.

**2.4 Industrial Ethernet Switches**

- .1 Supply and install Ethernet switches in all control panels housing programmable logic controllers (PLCs) that interface to the plant control and operator interface network. Connect to PLC's, meters and all other Ethernet capable equipment resident within the control panel using cable rated for 100 Base-TX communication.
- .2 Switches shall comply with Institute of Electrical and Electronic Engineers (IEEE) 802.3, 802.3u, 802.3x, 802.1D.
- .3 Switches shall include a minimum of 5 10/100 Base T(x) RJ45 Ports and 2 multimode 100 Base FX Fiber ports.
- .4 Switches shall include one (1) relay output alarm contact rated for 1A@24 VDC.
- .5 Input power shall be capable of ranging from 9 to 32 VDC with redundant inputs.
- .6 Switches shall be fast spanning for a sub-second recovery in a ring configuration.
- .7 Switches shall be Eagle Technology ED6008 Series, Schneider ConneXium Series or approved equal.

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**MISCELLANEOUS PANEL DEVICES**

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**2.5 Fiber Termination Panel**

- .1 Supply and install a fibre termination panel suitable for the termination of two (2) 12-strand multimode fibre optic cables in all control panels housing PLCs, PLC remote I/O racks, or Human Machine Interfaces (HMI) that interface to the plant control and operator interface network.

**3. EXECUTION**

**3.1 References - General**

- .1 Refer to **Section 17010 – Instrumentation and Control General Requirements**, Part 3.

**END OF SECTION**

## **PROGRAMMABLE LOGIC CONTROLLERS**

---

### **1. GENERAL**

#### **1.1 References - General**

- .1 Equipment, Products and Execution must meet all requirements detailed in **Section 17010 – Instrumentation and Control General Requirements**.

#### **1.2 Work Included**

- .1 Design and supply of a programmable logic controller (PLC) based control system that will control and monitor the system in accordance with the requirements defined in **Division 16**.
- .2 PLC's and Inputs/Outputs (I/O) shall be housed in a central control panel.
- .3 PLC's shall be programmed using the latest version of Schneider Electric's Unity Programming Software. The program shall be fully documented and programmed according to standards that will be provided by the Contract Administrator.
- .4 The final PLC configuration program shall be provided to the City on compact disk.
- .5 Start-up and commissioning assistance as required for the control system.

#### **1.3 Related Work**

- .1 General Provisions: **Division 16**

### **2. PRODUCTS**

#### **2.1 PLC's**

- .1 General
  - .1 All new PLC equipment to be based on the Modicon Unity Processor family as applicable (no substitutions allowed).
  - .2 All PLC's shall be Unity hot standby processors complete with redundant processors.
  - .3 Communication protocol for the new PLC network shall be Modbus/TCP. Ethernet communication modules shall be provided in each PLC rack to interface to the plant control network.
  - .4 Provide all necessary racks, power supplies, cables, communication cards, and accessories.
  - .5 Provide spares of all PLC system components (minimum of one of each exact type) supplied including: power supply, processor, communication modules, and input/output modules.

## **PROGRAMMABLE LOGIC CONTROLLERS**

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- .6 Provide 10% spare slot capacity for each PLC panel assembly.
  - .7 Provide 25% spare power supply capacity for each PLC panel assembly.
  - .8 PLC racks shall be powered from the external uninterruptible power supply (UPS) system. Each new PLC panel assembly shall include Sola Hevi-Duty STV100K series incoming power transient surge suppression or approved equal. Connect the surge suppressor dry contact to a PLC input and configure as an alarm on the control system at each panel.
- .2 PLC
- .1 Modicon Unity main processor and hot standby Central Processing Unit (CPU): Model Number 140 CPU 671 60.
  - .2 Modicon NOE (Modbus/TCP) modules for each processor rack.
  - .3 Redundant cable remote I/O modules in each rack: Model Numbers 140 CRP 932 00 and 140 CRA 932 00.
  - .4 I/O modules to meet the specifications defined herein.
- .3 I/O.
- .1 120 VAC Digital Inputs: Model Number 140 DAI 540 00.
  - .2 24 VDC Digital Inputs: Model Number 140 DAI 340 00.
  - .3 Digital Outputs: Model Number 140 DAO 840 00.
  - .4 Analog Inputs: Model Number 140 ACI 030 00.
  - .5 Analog Outputs: Model Number 140 ACO 020 00.
  - .6 Provide at least 20% spare I/O of each type in each panel assembly.

### **2.2 System Integration Requirements**

- .1 The PLC Control System will be integrated with the Water Treatment Plant supervisory Control and Data Acquisition (SCADA) System. The Contractor shall provide a detailed register map for data exchange which allows full monitoring and control of the standby generators and 5 kV switchgear from the SCADA system.
- .2 Cooperate with other contractors, City, and Contract Administrator to facilitate installation, testing, validation, and commissioning of the control system.
- .3 Assist the Systems Integrator to establish communication with the PLC's. Test data exchange between the PLC Control System and the Water Treatment Plant SCADA system as defined in this Section and the process description.

**PROGRAMMABLE LOGIC CONTROLLERS**

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**3. EXECUTION**

**3.1 References – General**

- .1 Refer to **Section 17010 – Instrumentation and Control General Requirements, Part 3.**

**END OF SECTION**

## OPERATOR INTERFACE REQUIREMENTS

---

### 1. GENERAL

#### 1.1 References – General

- .1 Equipment, products, and execution must meet all requirements detailed in **Section 17010 – Instrumentation and Control General Requirements**.

#### 1.2 General Requirements

- .1 Local control and Operator Interface requirements
  - .1 Provide all necessary local controls to allow local operation that compliments the operation of the plant control system and facilitates satisfactory system control consistent with the intent of this Specification. The extent of local controls to be provided shall be fully described as part of the submittals defined in **Division 16**.
  - .2 Provide a local operator interface consisting of an industrial grade personal computer (PC) complete with graphical interface software that has been configured for the application.
  - .3 The graphical interface software shall be fully documented and programmed according to standards that will be provided by the Contract Administrator.
  - .4 The final graphical interface configuration shall be fully documented and shall be provided to the City on compact disk prior to substantial performance.
  - .5 Configuration software and all associated licenses and tools required to maintain and re-configure the software shall be provided to the City prior to substantial performance.
  - .6 Detailed local control and operator interface requirements are defined in **Division 16**.
- .2 Interface to the Water Treatment Plant Supervisory Control and Data Acquisition (SCADA) System
  - .1 The Operator Interface for the plant SCADA system will be supplied, installed, programmed, and commissioned by others. The Contractor shall provide all information necessary for the Systems Integrator to create a complete and comprehensive remote monitoring and control system consistent with the requirements of this document.
  - .2 This Contractor is to support the design, installation, programming, and start-up of the plant SCADA system as follows:
    - .1 Supply all field instrumentation necessary to facilitate both local and remote monitoring and control of the system.



## **OPERATOR INTERFACE REQUIREMENTS**

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- .2 Provide all hardware interfaces required to facilitate the interconnection of the Contractor supplied programmable logic controller (PLC) control system to the plant SCADA system.
  - .3 Provide all written descriptions and associated drawings necessary to fully describe the detailed operation of the entire system supply and to allow the control System Integrator to develop application software on the plant operator interface network. This includes the PLC control logic software, recommended operator interface points, alarm lists, recommended historical trend and long-term data storage points, PLC tag lists and sample graphics screens as developed for the local operator interface, either as print-out or in electronic bitmap format.
  - .4 Update all system documentation after the completion of **Form T1** to reflect the final installation.
- .3 Coordinate the implementation of tag name and numbering conventions for all instrumentation with the Contract Administrator.

## **2. PRODUCTS**

### **2.1 Local Operator Interface**

- .1 Provide a local Operator Interface consisting of an industrial grade PC complete with an application specific graphical interface configured using InTouch Version 9.0 HMI software by ISS Wonderware, OASyS DNA by Telvent, or approved equal. The industrial grade PC shall be provided with the HMI software provider's recommended system hardware and operating system.
- .2 Minimum requirements of the industrial PC are as follows:
  - .1 15 inch color flat screen display
  - .2 Membrane keypad and mouse
  - .3 Dual Ethernet ports.

## **3. EXECUTION**

### **3.1 Performance – General**

- .1 Refer to **Section 17010 – Instrumentation and Control General Requirements**, Part 3.

### **3.2 Installation**

- .1 Installation by others.
- .2 Provide installation assistance in accordance with **Section 01650 – Equipment Installation**.

**OPERATOR INTERFACE REQUIREMENTS**

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- .3 Provide hardware in accordance with the foregoing requirements in sufficient quantity to satisfy the performance requirements defined in this and other Divisions of this Specification.
- .4 Provide all necessary documentation to complete the configuration of the control system including I/O lists, alarm lists, critical process variables, instrumentation lists, loop wiring requirements for I/O, local control equipment details, and detailed system operation descriptions.

**END OF SECTION**