



THE CITY OF WINNIPEG

BID OPPORTUNITY

BID OPPORTUNITY NO. 571-2005

WINNIPEG WATER TREATMENT PROGRAM - SUPPLY OF DEACON BOOSTER PUMPS

TABLE OF CONTENTS

PART A - BID SUBMISSION

| | |
|---|---|
| Form A: Bid | 1 |
| Form B: Prices | 4 |
| Form G1: Bid Bond and Agreement to Bond | 6 |
| Form G2: Irrevocable Standby Letter of Credit and Undertaking | 8 |

PART B - BIDDING PROCEDURES

| | |
|---|---|
| B1. Project Title | 1 |
| B2. Submission Deadline | 1 |
| B3. Site Investigation | 1 |
| B4. Enquiries | 1 |
| B5. Addenda | 1 |
| B6. Substitutes | 2 |
| B7. Bid Submission | 3 |
| B8. Bid | 3 |
| B9. Prices | 4 |
| B10. Qualification | 4 |
| B11. Bid Security | 6 |
| B12. Opening of Bids and Release of Information | 6 |
| B13. Irrevocable Bid | 7 |
| B14. Withdrawal of Bids | 7 |
| B15. Evaluation of Bids | 7 |
| B16. Award of Contract | 8 |

PART C - GENERAL CONDITIONS

| | |
|------------------------|---|
| C1. General Conditions | 1 |
|------------------------|---|

PART D - SUPPLEMENTAL CONDITIONS

General

| | |
|----------------------------|---|
| D1. General Conditions | 1 |
| D2. Scope of Work | 1 |
| D3. Definitions | 2 |
| D4. Contract Administrator | 3 |
| D5. Notices | 4 |
| D6. Indemnity | 4 |

Submissions

| | |
|------------------------------------|---|
| D7. Authority to Carry on Business | 5 |
| D8. Workers Compensation | 5 |
| D9. Insurance | 5 |
| D10. Performance Security | 6 |
| D11. Subcontractor List | 6 |
| D12. Work Schedule | 6 |
| D13. Security Clearance | 7 |
| D14. Instrumentation and Controls | 7 |

Schedule of Work

| | |
|------------------------------|----|
| D15. Commencement | 8 |
| D16. Critical Stages | 8 |
| D17. Substantial Performance | 9 |
| D18. Total Performance | 9 |
| D19. Liquidated Damages | 10 |

Measurement and Payment

| | |
|-----------------------|----|
| D20. Payment Schedule | 10 |
|-----------------------|----|

Warranty

| | |
|---------------|----|
| D21. Warranty | 11 |
|---------------|----|

CONTROL OF WORK

| | |
|---|----|
| D22. Prime Contractor – The Workplace Safety And Health Act | 11 |
|---|----|

| | |
|---------------------------|----|
| Form H1: Performance Bond | 12 |
|---------------------------|----|

| | |
|---|----|
| Form H2: Irrevocable Standby Letter of Credit | 14 |
|---|----|

| | |
|----------------------------|----|
| Form J: Subcontractor List | 16 |
|----------------------------|----|

PART E - SPECIFICATIONS

General

| | |
|-------------|---|
| E1. General | 1 |
|-------------|---|

| | |
|-----------|---|
| E2. Goods | 2 |
|-----------|---|

Division 01 – General Requirements

| | |
|-------|-----------------------------------|
| 01300 | Submittals |
| 01400 | Quality Control |
| 01650 | Equipment Installation |
| 01730 | Operation and Maintenance Manuals |

Division 11 – Process

| | |
|--------|---|
| 11000 | Equipment General Provisions |
| 11200 | Process Motors |
| 11300 | Process Pump General Requirements |
| 11320 | Process Pumps Horizontal Centrifugal Pumps |
| 11320a | Detailed Pump Specification |
| 11330 | Variable Speed Drives |
| 11901 | Factory Applied Maintenance and Corrosion Protection Coatings |

Division 16 - Electrical

| | |
|-------|---------------------------|
| 16815 | Variable Frequency Drives |
|-------|---------------------------|

Division 17 – Instrumentation and Controls

| | |
|-------|--|
| 17010 | Instrumentation and Control General Requirements |
| 17110 | Enclosures |
| 17124 | Instrumentation Cable |
| 17211 | Process Taps and Primary Elements |
| 17212 | Transmitters and Indicators |
| 17213 | Powered Actuators |
| 17216 | Switches and Relays |
| 17501 | Operator Interface Requirements |

PART B - BIDDING PROCEDURES

B1. PROJECT TITLE

B1.1 WINNIPEG WATER TREATMENT PROGRAM - SUPPLY OF DEACON BOOSTER PUMPS

B2. SUBMISSION DEADLINE

B2.1 The Submission Deadline is 4:00 p.m. Winnipeg time, December 2, 2005.

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. SITE INVESTIGATION

B3.1 Further to GC.2.01, the Contract Administrator or an authorized representative will be available at the Site from 1:00 p.m. to 2:00 p.m. on November 24, 2005.

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

B4. ENQUIRIES

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

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

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

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

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

B5. ADDENDA

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

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

- B5.2.1 Addenda will be available on the Bid Opportunities page at The City of Winnipeg, Corporate Finance, Materials Management Branch internet site at <http://www.winnipeg.ca/matmgt>.
- B5.2.2 The Bidder is responsible for ensuring that he has received all addenda and is advised to check the Materials Management Branch internet site for addenda shortly before submitting his Bid.
- B5.3 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.

B6. SUBSTITUTES

- B6.1 The Work is based on the materials, equipment, methods and products specified in the Bid Opportunity.
- B6.2 Substitutions shall not be allowed unless application has been made to and prior approval has been granted by the Contract Administrator in writing.
- B6.3 Requests for approval of a substitute will not be considered unless received in writing by the Contract Administrator at least seven (7) Business Days prior to the Submission Deadline.
- B6.4 The Bidder shall ensure that any and all requests for approval of a substitute:
- (a) provide sufficient information and details to enable the Contract Administrator to determine the acceptability of the 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.
- B6.5 The Contract Administrator, after assessing the request for approval of a substitute, may in his sole discretion grant approval for the use of a substitute as an “approved equal” or as an “approved alternative”, or may refuse to grant approval of the substitute.
- B6.6 The Contract Administrator will provide a response in writing, at least two (2) Business Days prior to the Submission Deadline, only to the Bidder who requested approval of the substitute.
- B6.6.1 The Bidder requesting and obtaining the approval of a substitute shall be entirely responsible for disseminating information regarding the approval to any person or persons he wishes to inform.
- B6.7 If the Contract Administrator approves a substitute as an “approved equal”, any Bidder may use the approved equal in place of the specified item.

B6.8 If the Contract Administrator approves a substitute as an “approved alternative”, any Bidder bidding that approved alternative 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 B15.

B6.9 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.

B7. BID SUBMISSION

B7.1 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;

B7.2 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.

B7.3 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.

B7.3.1 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.

B7.4 Bid Submissions submitted by facsimile transmission (fax) or internet electronic mail (e-mail) will not be accepted.

B7.5 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

B8. BID

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

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

- (a) if the Bidder is a sole proprietor carrying on business in his own name, his name shall be inserted;
- (b) if the Bidder is a partnership, the full name of the partnership shall be inserted;
- (c) if the Bidder is a corporation, the full name of the corporation shall be inserted;
- (d) if the Bidder is carrying on business under a name other than his own, the business name and the name of every partner or corporation who is the owner of such business name shall be inserted.

- B8.2.1 If a Bid is submitted jointly by two or more persons, each and all such persons shall identify themselves in accordance with B8.2.
- B8.3 In Paragraph 3 of Form A: Bid, the Bidder shall identify a contact person who is authorized to represent the Bidder for purposes of the Bid.
- B8.4 Paragraph 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.
- B8.4.1 The name and official capacity of all individuals signing Form A: Bid shall be printed below such signatures.
- B8.4.2 All signatures shall be original and shall be witnessed except where a corporate seal has been affixed.
- B8.5 If a Bid is submitted jointly by two or more persons, the word "Bidder" shall mean each and all such persons, and the undertakings, covenants and obligations of such joint Bidders in the Bid Submission and the Contract, when awarded, shall be both joint and several.

B9. PRICES

- B9.1 The Bidder shall state the price in Canadian funds for each item of the Work identified on Form B: Prices, for Alternative 1, Alternative 2, or both.
- B9.1.1 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.
- B9.1.2 The price on Form B: Prices shall not include the Manitoba Association for Resource Recovery Corporation (MARRC) Environmental Handling Charge (EHC) which shall be extra where applicable.
- B9.2 Payment of the unit prices will be made to the Contractor in accordance with the payment schedule set out in D20.

B10. QUALIFICATION

- B10.1 The Bidder shall:
- (a) undertake to be in good standing under The Corporations Act (Manitoba), or properly registered under The Business Names Registration Act (Manitoba), or otherwise properly registered, licensed or permitted by law to carry on business in Manitoba, 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);

B10.2 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.

B10.2.1 Proof satisfactory to the Contract Administrator may include (but is not limited to):

- (a) Evidence that the Bidder has:
 - (i) successfully supplied a minimum of five (5) installations, similar in nature, scope and value to the Work;
 - (ii) successfully supplied work, similar in nature, scope and value to the Work for a minimum of five (5) years; and
 - (iii) a representative and service center located in North America.
- (b) Detailed pump curves illustrating the adequacy of the proposed pumps and motor horsepower requirements.

B10.2.2 Evidence given by the Bidder to demonstrate qualification pursuant to B10.2.1(a) (i) and B10.2.1(a) (ii) shall be in the form of references to similar work carried out by the Bidder and/or proposed Subcontractor and shall include:

- (a) Year of completion;
- (b) Value of work;
- (c) Client;
- (d) Client contact name and telephone number; and
- (e) Description of contract.

B10.2.3 Determination of the satisfactory performance or success of the installation references shall be at the sole discretion of the Contract Administrator, based on the Contract Administrator's contact with the referenced installations.

B10.3 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.

B11. BID SECURITY

B11.1 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.

B11.1.1 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.

B11.2 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.

B11.2.1 Where the bid security provided by the successful Bidder is in the form of a certified cheque or draft pursuant to B11.1(c), it will be deposited and retained by the City as the performance security and no further submission is required.

B11.2.2 The City will not pay any interest on certified cheques or drafts furnished as bid security or subsequently retained as performance security.

B11.3 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.

B12. OPENING OF BIDS AND RELEASE OF INFORMATION

B12.1 Bid Submissions will not be opened publicly.

B12.2 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>.

B12.3 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>.

B12.4 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.

B13. IRREVOCABLE BID

- B13.1 The Bid(s) submitted by the Bidder shall be irrevocable for the time period specified in Paragraph 11 of Form A: Bid.
- B13.2 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.

B14. WITHDRAWAL OF BIDS

- B14.1 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.
- B14.1.1 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.
- B14.1.2 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.
- B14.1.3 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 B14.1.3(b), declare the Bid withdrawn.
- B14.2 A Bidder who withdraws his Bid after the Submission Deadline but before his Bid has been released or has lapsed as provided for in B13.2 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.

B15. EVALUATION OF BIDS

- B15.1 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 B10 (pass/fail);
 - (c) Evaluated Bid Price;
 - (d) economic analysis of any approved alternative pursuant to B6.
- B15.2 Further to B15.1(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.
- B15.3 Further to B15.1(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.

- B15.4** Further to B14.1(c), the Evaluated Bid Price shall be the Total Bid Price adjusted for the comparison of Bids only, by adding construction and maintenance costs based on a twenty (20) year life cycle cost analysis.
- B15.4.1** If there is any discrepancy between the Total Bid Price written in figures, the total Bid Price written in words and the sum of the quantities multiplied by the unit prices for each item, the sum of the quantities multiplied by the unit prices for each item shall take precedence.
- B15.4.2** The construction cost adjustment will be applied only to Alternative 1 and will be based on the cost to provide a future starter for the new motors.
- B15.4.3** The maintenance cost adjustment will be the maintenance cost for the equipment based on:
- (a) A service life of twenty (20) years for the VSDs used in Alternative 1, and a service life of five (5) years for the VFDs used in Alternative 2.
 - (b) The estimated service life of five (5) years for the VFDs used in Alternative 2 will be assumed unless the Bidder provides the Contract Administrator with:
 - (i) An extended warranty of longer than five (5) years; or
 - (ii) Independently verified evidence that a longer service life is consistently achieved in existing installations of similar size, application and value. This evidence shall include (but is not limited to) statistical data that demonstrates the validity of the claim to the satisfaction of Contract Administrator.
 - (c) Requests that the Contract Administrator consider a service life longer than five (5) years for the VFDs used in Alternative 2 shall be made in accordance with B6, prior to the Bid Submission deadline.
 - (d) This Contract will be awarded based on: Alternative 1 – pumps, motors and variable speed drives or Alternative 2 – pumps, motors and variable frequency drives. In either case, the City reserves the right to purchase item 1 only.
 - (e) The Bidder is not required to bid on more than one alternative.
 - (f) The City shall have the right to choose the alternative that is in its best interests. If the Bidder has not bid on both alternatives, he shall have no claim against the City if his partial Bid is rejected in favour of an award of the Contract on the basis of an alternative upon which he has not bid.

B16. AWARD OF CONTRACT

- B16.1** The City will give notice of the award of the Contract or will give notice that no award will be made.
- B16.2** 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.
- B16.2.1** Without limiting the generality of B16.2, 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.

B16.3 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 two centrifugal booster pumps with variable speed drives.
- D2.2 The major components of the Work are as follows:
- (a) Alternative 1: To supply two (2) centrifugal pumps, motors, and variable speed drives including delivery to Site, training, performance verification support, operation and maintenance manuals, accessories and spare parts.
 - (b) Alternative 2: To supply two (2) centrifugal pumps, motors, three (3) variable frequency drives, and two (2) soft starter by-passes, delivery to Site, training, performance verification support, operation and maintenance manuals, accessories, and spare parts.
 - (c) Services as specified in section 01650 and instrumentation scope as specified in section 17010.
 - (d) Performance verification shall be demonstrated in two phases:
 - (i) to achieve Substantial Performance, the Contractor shall assist the Installer in demonstrating the equipment operates in conformance with the specifications under simulated inlet conditions
 - (ii) to achieve Total Performance, the Contractor shall return to the Site between July 3, 2007 and September 3, 2007, when the Clearwell is expected to be operational and assist the Installer in demonstrating conformance with the specifications under actual inlet conditions
- 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. The Contractor shall be responsible

for the payment all fees and acquire all permits from the authority having jurisdiction as required by GC.7.01.

D2.3.3 All truck deliveries shall approach the Site by heading north on PR207.

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) **CEC means Canadian Electrical Code**
- (r) **LOX** means liquid oxygen
- (s) **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.
- (t) **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.
- (u) **IEEE** means Institute of Electrical and Electronics Engineers
- (v) **NEMA** means National Electrical Manufacturer's Association
- (w) **Furnish** means supply
- (x) **ISA** means the Instrumentation Systems and Automation Society
- (y) **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
- (z) **AGMA** means American Gear Manufacturer's Association.
- (aa) **API** means American Petroleum Institute
- (bb) **EEMAC** means Electrical and Electronic Manufacturer of Canada

- (cc) **VSD** means Variable Speed Drive
 - (dd) **VFD** means Variable Frequency Drive
 - (ee) **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
 - (ff) **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
 - (gg) **Professional Engineer** means a professional engineer registered in the Province of Manitoba.
 - (hh) **Major Equipment** means all equipment for which shop drawing submittals are required as specified in Division 11, 16 and 17.
 - (ii) **Process Unit** means the Manufacturer's complete equipment package including individual process components, skid mounted equipment and any related appurtenances.
 - (jj) **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.
 - (kk) **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
 - (ll) **Control System Integrator** means a contractor retained by the City (under a different contract) to program and configure the water treatment plant SCADA system.
 - (mm) **Systems Integrator** means Control Systems Integrator.
 - (nn) **SCADA** means supervisor control and data acquisition.
- 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

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 B11.1(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 Search Certificate from the police service having jurisdiction at his place of residence.
- D13.2 Prior to the commencement of any Work on the Site, 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.

D14. INSTRUMENTATION AND CONTROLS

- D14.1 Within ten (10) business days of the notification of the Award of Contract by the way of Letter of Intent, the Contractor shall provide a list of products to be provided under Division 17.

SCHEDULE OF WORK

D15. COMMENCEMENT

- D15.1 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.
- D15.2 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 Contract Work Schedule specified in D12 and
 - (vii) the security clearances specified in D13
 - (a) the Contractor has attended a post-award 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.

D16. CRITICAL STAGES

- D16.1 The Contractor shall achieve critical stages of the Work in accordance with the following requirements:
- (a) Shop Drawings:
 - (i) 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.
 - (b) Delivery:
 - (i) Delivery of Goods to the site shall begin no earlier than November 1, 2006 and be completed no later than December 31, 2006,
 - (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) Delivery of the Goods 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 are included in Section 01650.
 - (c) Satisfactory Installation: The Contractor shall provide support to the Installation Contractor as required to achieve satisfactory installation of All Goods by February 28, 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 single form is required for each pump and a separate form for the entire system.

- (d) Satisfactory Performance and Training: Performance Verification and Training shall begin no earlier than February 28, 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 and training shall be considered complete upon the issuance of Form 103: Certificate of Equipment Satisfactory Performance and Form T1: Certificate of Satisfactory Training.

D16.2 The Contract Administrator will endeavour to review Shop Drawings within ten (10) Calendar Days upon their submission. If review is not made within that time period, Contract dates specified in D16.1(a) will be extended by an equivalent number of Calendar Days.

D16.3 All Shop Drawings submitted pursuant to D16.1(a) shall be provided in a single submission.

D17. SUBSTANTIAL PERFORMANCE

D17.1 The Contractor shall achieve Substantial Performance by May 1, 2007.

D17.2 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.

D17.3 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.

D17.4 Substantial Performances cannot be achieved without completion of Forms 103 and T1 for all Major Equipment supplied under this Contract.

D18. TOTAL PERFORMANCE

D18.1 The Contractor shall achieve Total Performance by December 31, 2007.

D18.2 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.

D18.3 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.

D18.4 Total Performance cannot be achieved without completion of a second set of Forms 103 and T1 for all Major Equipment supplied under this Contract.

D19. LIQUIDATED DAMAGES

- D19.1 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) Acceptable Shop Drawings in accordance with D16.1(a) – two thousand, six hundred dollars (\$2,600.00);
 - (b) Delivery in accordance with D16.1(b) – two thousand, six hundred dollars (\$2,600.00);
 - (c) Satisfactory installation in accordance with D16.1(c) - zero dollars (\$0.00);
 - (d) Substantial Performance – two thousand, six hundred dollars (\$2,600.00);
 - (e) Total Performance – six hundred dollars (\$600).
- D19.2 The amounts specified for liquidated damages in D19.1 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.
- D19.3 The City may reduce any payment to the Contractor by the amount of any liquidated damages assessed.
- D19.4 The City will not pay a bonus if the Contractor reaches critical stages, Substantial Performance or Total Performance earlier than the dates specified herein.

MEASUREMENT AND PAYMENT

D20. PAYMENT SCHEDULE

- D20.1 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 unit prices as listed in Form B: Prices, shall include all Shop Drawings, equipment, accessories, spare parts, delivery, performance verification and training.
 - (i) One (1) percent of the unit price will be paid upon the issuance of Certified Shop Drawings for the entire scope of this supply Contract.
 - (ii) Seventy four (74) percent of the unit 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.
 - (iii) A further ten (10) percent of the unit price will be paid upon issuance of Form 102: Certificate of Satisfactory Installation.
 - (iv) A further five (5) percent of the unit price will be paid upon the issuance of Form 103: Certificate of Satisfactory Performance pursuant to Substantial Performance.
 - (v) A further two and one half (2.5) percent of the unit price will be paid upon the issuance of Form T1: Certificate of Satisfactory Training pursuant to Substantial Performance.
 - (vi) A further five (5) percent of the unit price will be paid upon the issuance of Form 103: Certificate of Satisfactory Performance pursuant to Total Performance.
 - (vii) A further two and one half (2.5) percent of the unit price will be paid upon issuance of Form T1: Certificate of Satisfactory Training pursuant to Total Performance.
 - (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

D21. WARRANTY

- D21.1 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.
- D21.2 Notwithstanding GC.10.01, GC.10.02 and D21.1, 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.
- D21.3 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.
- D21.4 The Warranty period for all goods specified in Section 11330 and Section 16815 shall be a minimum of two years from Total Performance.
- D21.5 Prior to Substantial Performance for Alternative 2, the Contractor shall provide a written approval from the VFD and motor manufacturers certifying that both pieces of equipment are compatible when used together and maintain their individual warranties. One such written approval shall be provided for each different VFD and motor pair.

CONTROL OF WORK

D22. PRIME CONTRACTOR – THE WORKPLACE SAFETY AND HEALTH ACT

- D22.1 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).
- D22.2 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.
- D22.3 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>. This plan may be updated periodically during the course of this project.

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. 571-2005

WINNIPEG WATER TREATMENT PROGRAM - SUPPLY OF DEACON BOOSTER PUMPS

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. 571-2005

WINNIPEG WATER TREATMENT PROGRAM - SUPPLY OF DEACON BOOSTER PUMPS

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> |
|--|---|
| <u>Division 01 – General Requirements</u> | |
| 01300 | Submittals |
| 01400 | Quality Control |
| 01650 | Equipment Installation |
| 01730 | Operation and Maintenance Manuals |
| <u>Division 11 – Process</u> | |
| 11000 | Equipment General Provisions |
| 11200 | Process Motors |
| 11300 | Process Pump General Requirements |
| 11320 | Process Pumps Horizontal Centrifugal Pumps |
| 11320a | Detailed Pump Specification |
| 11330 | Variable Speed Drives |
| 11901 | Factory Applied Maintenance and Corrosion Protection Coatings |
| <u>Division 16 - Electrical</u> | |
| 16815 | Variable Frequency Drives |
| <u>Division 17 – Instrumentation and Controls</u> | |
| 17010 | Instrumentation and Control General Requirements |
| 17110 | Enclosures |
| 17124 | Instrumentation Cable |
| 17211 | Process Taps and Primary Elements |
| 17212 | Transmitters and Indicators |
| 17213 | Powered Actuators |
| 17216 | Switches and Relays |
| 17501 | Operator Interface Requirements |

Drawings

| <u>Drawing No.</u> | <u>Description</u> |
|--------------------|---|
| WX-M001 | Process – Lower Level Plan – General Arrangement |
| WX-M002 | Process – Overall Sections – A-A, B-B and C-C |
| WD-P0001 | Process – DBPS Upgrade – Process Flow Diagram |
| WD-P0002 | Process – DBPS Upgrade – Branch 1 Booster Pumps – Process and Instrumentation Diagram |
| WD-P0003 | Process – DBPS Upgrade – Branch 1 Booster Pumps – Process and Instrumentation Diagram |

E2. GOODS

- E2.1 The Contractor shall supply centrifugal pumps, motors and drives in accordance with the requirements hereinafter specified.

SUBMITTALS

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 registered in the Province of Manitoba, 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

- .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 will return the reproducible copy with comments transcribed.
- .4 Cross-reference Shop Drawing information to applicable portions of the Contract Documents.

SUBMITTALS

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

1.5 Product Data

- .1 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

- .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

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 Tender closing.
- .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 process equipment and systems, conveying equipment and systems, mechanical, electrical, and instrumentation and control (I&C) equipment and systems.
 - .3 Mill tests and certificates of compliance.
 - .4 Tests for reinforcing steel unidentified by mill test reports.
- .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.

QUALITY CONTROL

- .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.
- .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 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.

QUALITY CONTROL

- .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.
- .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

1. INTENT

- .1 This Section describes general requirements for equipment relating to the supply, verification of the on-site equipment 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 The Contractor shall arrange for the attendance of the Manufacturer's Representative to meet with the Installation Contractor to provide instructions in the methods, techniques, precautions, and any other information relevant to the successful installation, before signing **Form 101**.
- .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 Installation Contractor 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 each individual unit process item of equipment.

EQUIPMENT INSTALLATION

5. INSTALLATION

- .1 If necessary, or if so directed by the Contract Administrator during the course of installation, the Installer may 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 Manufacturer shall provide the required clarification at the Contractor's cost.
- .2 If it is found necessary, or if so directed by the Contract Administrator, the Installer shall contact the Contractor who shall arrange for the Manufacturer's Representative to visit the Site to provide assistance during installation, all at the Contractor's cost.
- .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 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 Installation 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 x 200 mm card stating "EQUIPMENT CHECKED. DO NOT RUN." stencilled in large black letters. Sign and date each card.
- .10 Provide a copy of **Form 102** for each system supplied under this contract.

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 Performance verification will be conducted at two (2) different intervals, once in 2006 and the other in 2007. The Contractor shall make provisions for attending both performance tests.

EQUIPMENT INSTALLATION

- .3 Performance verification in 2006 will be conducted under the Deacon reservoir static head conditions, which is approximately 6 m greater than the design static head condition of the future clear well.
- .4 Performance verification in 2007 will be conducted under the design static head conditions as specified in **Section 11320a – Detailed Pump Specification**.
- .5 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.
- .6 All operation and performance verification testing requiring coordination with the City, the Installer, or the Contract Administrator shall conform to the project master schedule.
- .7 The Manufacturer's Representative shall conduct all necessary checks to equipment and if necessary, advise the Installer of any further checking, flushing, cleaning, or other Work needed prior to confirming the equipment is ready to run.
- .8 The Contractor shall then operate the equipment for at least one (1) hour 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.
- .9 The Contractor shall then notify the Contract Administrator of his readiness to demonstrate the operation of the equipment. The Contract Administrator shall attend, as expeditiously as possible.
- .10 Substantial Performance verification to be conducted in 2006 shall be demonstrated as follows:
 - .1 With the assistance of the Manufacturer's Representative, the Contractor shall demonstrate that the equipment is properly installed. Alignment, piping connections, electrical connections, etc. shall be checked and if appropriate, code certifications provided.
 - .2 The equipment shall then be run for one (1) hour once the equipment has reached its normal operating temperature. 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.
 - .3 On satisfactory completion of the one (1) hour demonstration, the equipment shall be stopped and critical parameters, such as alignment, shall be rechecked.
 - .4 The equipment will be restarted and run continuously for five (5) days. The Manufacturer's Representative shall be On-Site for a minimum of five (5) days during the Substantial Performance verification. During this period, as practicable, conditions

EQUIPMENT INSTALLATION

shall be simulated which represent the full range of operating conditions. These conditions shall be mutually agreed by the Manufacturer's Representative, the Contractor, and the Contract Administrator on the basis of the information contained in the technical specifications, as well as the methods utilized to create the simulated conditions and the time periods allotted to each.

- .5 Performance tests shall be conducted either concurrent with or subsequent to the running test, as practicable and agreed between the Contract Administrator and the Contractor. Performance tests of equipment shall be carried out jointly with the City's Supervisory Control and Data Acquisition (SCADA) programming team. Trending of temperature, vibration etc. will be conducted during the performance testing. Instrumentation and Controls (I&C) connected to the marshalling panel shall include, but not to be limited to, simulation through SCADA. 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.
- .6 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.
- .7 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 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.
- .8 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.
- .9 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.
- .10 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.
- .11 Total Performance verification to be conducted in 2007 shall be demonstrated as follows:
 - .1 The equipment will be restarted and run continuously for five (5) days. The Manufacturer's Representative shall be on-site for a minimum of five (5) days during

EQUIPMENT INSTALLATION

the Total Performance verification. During this period, as practicable, conditions shall be simulated which represent the full range of operating conditions. These conditions shall be mutually agreed by the Manufacturer's Representative, the Contractor, and the Contract Administrator on the basis of the information contained in the technical specifications, as well as the methods utilized to create the simulated conditions and the time periods allotted to each.

- .2 A twenty eight (28) day commissioning period shall commence in accordance with the construction schedule. The equipment shall be operated by the Installation Contractor continuously 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. For equipment that is designed not to operate on a daily basis, the commissioning period shall be defined as twenty eight (28) consecutive days over which the piece of equipment is operated. 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.

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. Training sessions shall be conducted prior to Substantial Performance in 2006 and prior to Total Performance in 2007.
- .2 The training sessions shall last two (2) days each. The training sessions shall be given twice per commissioning year, 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 five (5) day operating period required for **Form 103**.
- .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 ($\frac{1}{2}$) an hour at the beginning of the first period for the Contract Administrator to provide a summary of the 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.

EQUIPMENT INSTALLATION

- .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.
- .9 Upon completion of training, the Contractor shall issue **Form T1: Certificate of Satisfactory Training**, complete with all required signatures.

EQUIPMENT INSTALLATION

**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

**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.

(Authorized Signing Representative of the Installer)

_____ Date

EQUIPMENT INSTALLATION

**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

**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

**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

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

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

- .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.

OPERATION AND MAINTENANCE MANUALS

.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

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

EQUIPMENT GENERAL PROVISIONS

1. GENERAL

1.1 Background

- .1 The City of Winnipeg treats and supplies potable water to a population of approximately 632,000 people. The source of supply for the City of Winnipeg is surface water originating from Shoal Lake. The water is chlorinated at the intake and is conveyed via an Aqueduct to the Deacon reservoir, located just east of the City. The Deacon reservoir consists of four (4) open cells and holds approximately fourteen (14) to twenty eight (28) days supply for the City. Water is rechlorinated as it leaves the reservoir through two (2) branch Aqueducts. The Water Distribution System contains three (3) regional distribution reservoirs and pumping stations.
- .2 The City wishes to enhance the treatment of its potable water. Currently the City is in the process of working toward the commissioning of ultraviolet (UV) disinfection equipment, which will be located after the Deacon reservoir to assist in inactivation of *Giardia* and *Cryptosporidium*.
- .3 The treatment process will be further enhanced by the construction of a filtration plant scheduled for completion in late 2007. The new filtration plant will consist of coagulation with ferric chloride, flocculation, clarification using dissolved air flotation (DAF), ozonation, filtration, followed by disinfection using chlorine, UV light, and chloramine. The purpose of this Bid Opportunity is to select and pre-purchase the Deacon booster pumps, motors, variable speed drives (VSDs), and associated equipment. The selected equipment will be used as the basis to finalize the design prior to construction with an Installer(s) selected through the public tendering process.

1.2 Requirements

- .1 The provisions of this Section shall apply to all equipment except where otherwise indicated.
- .2 Substantiating calculations, preliminary Drawings and proposed pump curves may be requested by the Contract Administrator after the Submission Deadline.

1.3 Reference Specifications, Codes, and Standards

- .1 Equipment shall be in accordance with the latest edition of the following standards, as applicable and as indicated in each equipment Specification:
 - .1 American Society for Testing and Materials (ASTM).
 - .2 American National Standards Institute (ANSI).
 - .3 American Society of Mechanical Engineers (ASME).
 - .4 American Water Works Association (AWWA).

EQUIPMENT GENERAL PROVISIONS

- .5 American Society of Heating, Refrigerating, and Air Conditioning Engineers (ASHRAE).
- .6 American Welding Society (AWS).
- .7 National Fire Protection Association (NFPA).
- .8 Federal Specifications (FS).
- .9 National Electrical Manufacturers Association (NEMA).
- .10 Manufacturer's published recommendations and Specifications.
- .11 General Industry Safety Orders (OSHA).
- .12 Canadian Standards Association (CSA).
- .13 Underwriters Laboratories of Canada (ULC).
- .2 The following standards are referenced in this Section:
 - .1 ANSI B16.1 - Cast Iron Pipe Flanges and Flanged Fittings, Class 25, 125, 250, and 800.
 - .2 ANSI B16.5 - Pipe Flanges and Flanged Fittings, Steel, Nickel Alloy and other Special Alloys.
 - .3 ANSI B46.1 - Surface Texture.
 - .4 ASME B1.20.1 - General Purpose Pipe Threads (Inch).
 - .5 ASME B31.1 - Power Piping.
 - .6 AWWA C206 - Field Welding of Steel Water Pipe.
 - .7 AWWA C207 - Steel Pipe Flanges for Waterworks Service - Sizes 4 In. through 144 In. (100 mm through 3,600 mm).
 - .8 AWWA D100 - Welded Steel Tanks for Water Storage.
 - .9 ASTM A 48 - Gray Iron Castings.
 - .10 ASTM A 108 - Steel Bars, Carbon, Cold-Finished, Standard Quality.

1.4 Contractor Submittals

- .1 Shop Drawings: Furnish submittals in accordance with **Section 01300 – Submittals**.
- .2 Equipment Installation: Complete all documentation as required within **Section 01650 – Equipment Installation**.

EQUIPMENT GENERAL PROVISIONS

- .3 Manuals: Provide manuals as specified within **Section 01730 – Operation & Maintenance Manuals**.
- .4 Spare Parts List: A spare parts list complete with the name, address, and telephone number of the nearest distributor for each piece of equipment shall be provided.
- .5 Torsion and Vibration Analyses
 - .1 Provide torsional and lateral vibration analyses for the following equipment types:
 - .1 Engine drives except engine generators.
 - .2 Pumps, blowers, and compressors with VSDs of 100 hp and greater.
 - .3 Vertical pumps with universal joints and extended shafts.
 - .4 Other equipment as indicated.
 - .2 An experienced specialist from the equipment Manufacturer shall perform a complete torsional and lateral vibration analysis of each distinct equipment, motor, and VSD. These analyses shall identify the dry and wet lateral critical speeds plus the torsional critical speeds of the system. Appropriate lateral and critical speed maps shall be produced and submitted.
 - .3 No active critical speed shall be allowed within 25% of the operating speed range. No fabrication of the equipment shall be started until the analyses have been reviewed and accepted by the Contract Administrator.

1.5 Quality Assurance

- .1 Costs: Pay all costs of inspection, start-up, testing, adjustment, and instruction services performed by Manufacturer's Representatives. The City will pay for power and water.
- .2 Quality and Tolerances: Tolerances and clearances shall be as shown on the Shop Drawings and shall be closely adhered to.
 - .1 Machine Work shall in all cases be of high-grade workmanship and finish, with due consideration to the special nature or function of the parts. Members without milled ends and which are to be framed to other steel parts of the structure may have a variation in the detailed length of not greater than 1.5 mm for members 10 m or less in length, and not greater than 3 mm for members over 10 m in length.
 - .2 Castings shall be homogeneous and free from non-metallic inclusions and defects. Surfaces of castings which are not machined shall be cleaned to remove foundry irregularities. Casting defects not exceeding 12.5% of the total thickness and where defects will not affect the strength and serviceability of the casting may be repaired by approved welding procedures.
 - .3 All materials shall meet the physical and mechanical properties in accordance with the reference standards.

EQUIPMENT GENERAL PROVISIONS

- .3 Machine Finish: The type of finish shall be the most suitable for the application and shall be shown in μin in accordance with ANSI B46.1. The following finishes shall be used:
- .1 Surface roughness not greater than 63 μin shall be required for all surfaces in sliding contact.
 - .2 Surface roughness not greater than 250 μin shall be required for surfaces in contact where a tight joint is not required.
 - .3 Rough finish not greater than 500 μin shall be required for other machined surfaces.
 - .4 Contact surfaces of shafts and stems which pass through stuffing boxes and contact surfaces of bearings shall be finished to not greater than 32 μin .

2. PRODUCTS

2.1 General Requirements

- .1 Noise Level: When in operation, no single piece of equipment shall exceed the OSHA noise level requirement of 85 dBA for one (1) hour exposure per day.
- .2 Drive Trains and Service Factors: Service factors shall be applied in the selection or design of mechanical power transmission components. All components of drive train assemblies between the prime mover and the driven equipment shall be designed and rated to deliver the maximum peak or starting torque, speed, and horsepower. All of the applicable service factors shall be considered, such as mechanical motors, load class, start frequency, ventilation, ambient temperature, and fan factors. Drive train components include couplings, shafts, gears and gear drives, drive chains, sprockets, and V-belt drives. Unless otherwise indicated, the following load classifications shall apply in determining service factors:

| Type of Equipment | Service Factor | Load Classification |
|--------------------------------|----------------|---------------------|
| Pumps | | |
| centrifugal or rotary | 1.0 | Uniform |
| progressing cavity | 1.0 | Uniform |
| vertical, mixed flow, or axial | 1.0 | Uniform |

.3 Mechanical Service Factors

| Mechanical Service Factors | |
|----------------------------|------|
| Electric Motor | |
| Uniform | 1.25 |
| Moderate Shock | 1.50 |
| Heavy Shock | 2.00 |

- .4 For thermal rating adjustments such as start frequency, ambient temperature, and hourly duty cycle factor, ventilation factor, and fan factor, refer to gear Manufacturer sizing information.

EQUIPMENT GENERAL PROVISIONS

- .5 Where load classifications are not indicated, service factors based on American Gear Manufacturer's Association (AGMA) 514.02 shall be used for standard load classifications and service factors for flexible couplings.
- .6 Welding: Unless otherwise indicated, welding shall conform to the following:
 - .1 Latest revision of AWWA D100.
 - .2 Latest revision of AWWA C206.
 - .3 Composite fabricated steel assemblies that are to be erected or installed inside a hydraulic structure, including any fixed or movable structural components of mechanical equipment, shall have continuous seal welds to prevent entrance of air or moisture.
 - .4 Welding shall be by the metal-arc method or gas-shielded arc method as described in the AWS "Welding Handbook" as supplemented by other pertinent standards of the AWS. Qualification of welders shall be in accordance with the AWS Standards.
 - .5 In assembly and during welding, the component parts shall be adequately clamped, supported, and restrained to minimize distortion and for control of dimensions. Weld reinforcement shall be as specified by the AWS code. Upon completion of welding, weld splatter, flux, slag, and burrs left by attachments shall be removed. Welds shall be repaired to produce a workmanlike appearance, with uniform weld contours and dimensions. Sharp corners of material that is to be painted or coated shall be ground to a minimum of 0.8 mm ($1/32$ inch) on the flat.
- .7 Protective Coating: Equipment shall be painted or coated as specified within each equipment Specification unless otherwise indicated. Non-ferrous metal and corrosion-resisting steel surfaces shall be coated with food grade grease or lubricating oil. Coated surfaces shall be protected from abrasion or other damage during handling, testing, storing, assembly, and shipping.
- .8 Protection of Equipment: Equipment shall be boxed, crated, or otherwise protected from damage and moisture during shipment, handling, and storage. Equipment shall be protected from exposure to corrosive fumes and shall be kept thoroughly dry at all times. Equipment delivered to the Site with rust or corroded parts shall be rejected.
- .9 Vibration Isolators: Air compressors, blowers, engines, inline fans shall be provided with restrained spring-type vibration isolators or pads per Manufacturer's written recommendations. Vibration isolations shall be provided with seismic restraint.
- .10 Controls: Equipment and system controls shall be in accordance with **Division 17**.

2.2 Equipment Supports

- .1 Equipment Supports: Unless otherwise indicated, equipment supports, anchors, and restrainers shall be adequately designed for static, dynamic, wind, and seismic loads. The design horizontal seismic force shall be the greater of: that noted in the general structural

EQUIPMENT GENERAL PROVISIONS

notes or as required by the governing building code, or 10% of gravity. Submitted design calculations for equipment supports shall bear the signature and seal of an Engineer registered in the Province of Manitoba, unless otherwise indicated.

2.3 Couplings

- .1 Mechanical couplings shall be provided between the driver and the driven equipment as detailed in this Specification or as recommended by the Manufacturer.
- .2 Each coupling size shall be determined based on the rated horsepower of the motor, speed of the shaft, and the load classification service factor. The equipment Manufacturer shall select or recommend the size and type of coupling required to suit each specific application.
- .3 Differential Settlement: Where differential settlement between the driver and the driven equipment may occur, two (2) sets of universal type couplings shall be provided.
- .4 Taper-Lock or equal bushings may be used to provide for easy installation and removal of shafts of various diameters.

2.4 Shafting

- .1 General: Shafting shall be continuous between bearings and shall be sized to transmit the power required. Keyways shall be accurately cut in line. Shafting shall not be turned down at the ends to accommodate bearings or sprockets whose bore is less than the diameter of the shaft. Shafts shall rotate in the end bearings and shall be turned and polished, straight, and true.
- .2 Design Criteria: All shafts shall be designed to carry the steady state and transient loads suitable for unlimited number of load applications, in accordance with ASME B106.1M, - Design of Transmission Shafting. Where shafts are subjected to fatigue stresses, such as frequent start and stop cycles, the mean stress shall be determined by using the modified Goodman Diagram. The maximum torsional stress shall not exceed the endurance limit of the shaft after application of the Factor of Safety of 2 in the endurance limit and the stress concentration factor of the fillets in the shaft and keyway. Stress concentration factor shall be in accordance with ASME Standard B17.1 - Keys and Keyseats.
- .3 Materials: Shafting materials shall be appropriate for the type of service and torque transmitted. Environmental elements such as corrosive gases, moisture, and fluids shall be taken into consideration. Materials shall be as indicated unless furnished as part of an equipment assembly.
 - .1 Low carbon cold-rolled steel shafting shall conform to ASTM A108, Grade 1018.
 - .2 Medium carbon cold-rolled shafting shall conform to ASTM A108, Grade 1045.
 - .3 Other grades of carbon steel alloys shall be suitable for service and load.
 - .4 Corrosion-resistant shafting shall be stainless steel or Monel, whichever is most suitable for the intended service.

EQUIPMENT GENERAL PROVISIONS

- .4 Differential Settlement: Where differential settlement between the driver and the driven equipment may occur, a shaft of sufficient length with two (2) sets of universal type couplings shall be provided.

2.5 Gears and Gear Drives

- .1 Unless otherwise indicated, gears shall be of the spur, helical, or spiral-bevel type, designed and manufactured in accordance with AGMA Standards, with a service factor suitable for load class, mechanical service and thermal rating adjustment, a minimum L-10 bearing life of sixty thousand (60,000) hours, and a minimum efficiency of 94%. Peak torque, starting torque, and shaft overhung load shall be checked when selecting the gear reducer. Worm gears shall not be used.
- .2 Gear speed reducers or increasers shall be of the enclosed type, oil- or grease-lubricated and fully sealed, with a breather to allow air to escape but keep dust and dirt out. The casing shall be of cast iron or heavy-duty steel construction with lifting lugs and an inspection cover for each gear train. An oil level sight glass and an oil flow indicator shall be provided, located for easy reading.
- .3 Gears and gear drives that are part of an equipment assembly shall be shipped fully assembled for field installation.
- .4 Material selections shall be left to the discretion of the Manufacturer, provided the above AGMA values are met. Input and output shafts shall be adequately designed for the service and load requirements. Gears shall be computer-matched for minimum tolerance variation. The output shaft shall have two (2) positive seals to prevent oil leakage.
- .5 Oil level and drain locations shall be easily accessible. Oil coolers or heat exchangers with all required appurtenances shall be provided when necessary.
- .6 Where gear drive input or output shafts from one Manufacturer connect to couplings or sprockets from a different Manufacturer, gear drive Manufacturer shall furnish a matching key taped to the shaft for shipment.
- .7 Ensure adequate process stream protection from oil and grease leaks/spills.

2.6 Drive Chains

- .1 Power drive chains shall be commercial type roller chains meeting ANSI Standards.
- .2 A chain take-up or tightener shall be provided in every chain drive arrangement to provide easy adjustment.
- .3 A minimum of one (1) connecting or coupler link shall be provided in each length of roller chain.
- .4 Chain and attachments shall be of the Manufacturer's best standard material and be suitable for the process fluid.

EQUIPMENT GENERAL PROVISIONS

2.7 Sprockets

- .1 General: Sprockets shall be used in conjunction with chain drives and chain-type material handling equipment.
- .2 Materials: Unless otherwise indicated, materials shall be as follows:
 - .1 Sprockets with twenty-five (25) teeth or less, normally used as a driver, shall be made of medium carbon steel in the 0.40 to 0.45% carbon range.
 - .2 Type A and B sprockets with twenty six (26) teeth or more, normally used as driven sprockets, shall be made of minimum 0.20% carbon steel.
 - .3 Large diameter sprockets with Type C hub shall be made of cast iron conforming to ASTM A48, Class 30.
- .3 Sprockets shall be accurately machined to ANSI Standards. Sprockets shall have deep hardness penetration in tooth Sections.
- .4 Finish bored sprockets shall be furnished complete with keyseat and set screws.
- .5 To facilitate installation and disassembly, sprockets shall be of the split type or shall be furnished with **Taper-Lock** bushings as required.
- .6 Idler sprockets shall be provided with brass or Babbitt bushings, complete with oil hole and axial or circumferential grooving with stainless steel tubing and grease fitting extended to an accessible location. Steel collars with set screws may be provided in both sides of the hub.

2.8 V-Belt Drives

- .1 V-belts and sheaves shall be of the best commercial grade and shall conform to ANSI, Mechanical Power Transmission Association (MPTA), and Rubber Manufacturer's Association (RMA) Standards.
- .2 Unless otherwise indicated, sheaves shall be machined from the finest quality grey cast iron.
- .3 Sheaves shall be statically balanced. In some applications where vibration is a problem, sheaves shall be dynamically balanced. Sheaves operating at belt speeds exceeding 6,500 fpm may be required to be of special materials and construction.
- .4 To facilitate installation and disassembly, sheaves shall be provided complete with **Taper-Lock** or **QD** bushings as required.
- .5 Finish bored sheaves shall be complete with keyseat and set screws.
- .6 Sliding motor bases shall be provided to adjust the tension of V-belts.

EQUIPMENT GENERAL PROVISIONS

2.9 Bearings

- .1 General: Bearings shall conform to the standards of the Anti-Friction Bearing Manufacturers Association, Inc. (AFBMA).
- .2 To assure satisfactory bearing application, fitting practice, mounting, lubrication, sealing, static rating, housing strength, and lubrication shall be considered in bearing selection.
- .3 Re-lubricatable type bearings shall be equipped with hydraulic grease fitting in an accessible location and shall have sufficient grease capacity in the bearing chamber.
- .4 Lubricated-for-life bearings shall be factory-lubricated with the Manufacturer's recommended grease to insure maximum bearing life and best performance.
- .5 Anti-Friction Type Bearing Life: Except where otherwise indicated, bearings shall have a minimum L-10 life expectancy of five (5) years or twenty thousand (20,000) hours, whichever occurs first. Where so indicated, bearings shall have a minimum rated L-10 life expectancy corresponding to the type of service, as follows:

| Type of Service | Design Life (years) | L-10 Design Life (hours) |
|-----------------|-------------------------|--------------------------|
| | (whichever comes first) | |
| 8 hour shift | 10 | 20,000 |
| 16 hour shift | 10 | 40,000 |
| Continuous | 10 | 60,000 |

- .6 Bearing housings shall be of cast iron or steel and bearing mounting arrangement shall be as indicated or as recommended in the published standards of the Manufacturer. Split-type housings may be used to facilitate installation, inspection, and disassembly.
- .7 Sleeve Type Bearings: Sleeve-type bearings shall have a cast iron or ductile iron housing and Babbitt or bronze liner. Bearing housing shall be bolted and doweled to the lower casing half. These housings shall be provided with cast iron caps bolted in place and the bearing end caps shall be bored to receive the bearing shells. Sleeve bearings shall be designed on the basis of the maximum allowable load permitted by the bearing Manufacturer. If the sleeve bearing is connected to an equipment shaft with a coupling, the coupling transmitted thrust will be assumed to be the maximum motor or equipment thrust. Lubricant, lubrication system, and cooling system shall be as recommended by the bearing Manufacturer.
- .8 Plate Thrust Bearings: Thrust bearings shall be the Kingsbury Type, designed and manufactured to maintain the shaft in the fixed axial position without undue heating or the necessity of adjustment or attention. Bearings shall be oil lubricated to suit the Manufacturer's standard method of lubrication for the specific bearing. If bearing cooling is required, the Manufacturer shall provide necessary piping, filters, and valves.
- .9 Ensure adequate process stream protection from bearing lubricant leaks.

EQUIPMENT GENERAL PROVISIONS

2.10 Piping Connections

- .1 Pipe Hangers, Supports, and Guides: The Installation Contractor will provide pipe connections to equipment that will be supported, anchored, and guided to avoid stresses and loads on equipment flanges and equipment.
- .2 Flanges and Pipe Threads: Flanges on equipment and appurtenances shall conform to ANSI B16.1, Class 125, or B16.5, Class 150, unless otherwise indicated. Pipe threads shall be in accordance with ANSI/ASME B1.20.1.
- .3 Flexible Connectors: Flexible connectors shall be provided in all piping connections to engines, blowers, compressors, and other vibrating equipment and in piping systems. Flexible connectors shall be harnessed or otherwise anchored to prevent separation of the pipe where required by the installation.
- .4 Insulating Connections: Insulating bushings, unions, couplings, or flanges, as appropriate, shall be used and supplied by the Contractor.

2.11 Gaskets and Packings

- .1 Packing around valve stems and reciprocating shafts shall be of compressible material, compatible with the fluid being used. Chevron-type "V" packing shall be **Garlock No. 432, John Crane "Everseal"**.
- .2 Packing around rotating shafts (other than valve stems) shall be "O"-rings, stuffing boxes, or mechanical seals, as recommended by the Manufacturer.

2.12 Nameplates

- .1 Equipment nameplates of stainless steel shall be engraved or stamped and fastened to the equipment in an accessible location with No. 4 or larger oval head stainless steel screws or drive pins. Nameplates shall contain the Manufacturer's name, model, serial number, size, characteristics, and appropriate data describing the machine performance ratings.

2.13 Tools and Spare Parts

- .1 Tools: Furnish one (1) complete set of special wrenches and other special tools necessary for the assembly, adjustment, and dismantling of the equipment. Tools shall be of best quality hardened steel forgings with bright finish. Wrench heads shall have work faces dressed to fit nuts. Tools shall be suitable for professional work and manufactured by **Snap On, Crescent, Stanley**, or equal. The set of tools shall be neatly mounted in a labelled toolbox of suitable design provided with a hinged cover.
- .2 Spare parts shall be furnished as indicated in the individual equipment Sections. All spare parts shall be suitably packaged in a metal box and labelled with equipment numbers by means of stainless steel or solid plastic nametags attached to the box.

EQUIPMENT GENERAL PROVISIONS

2.14 Equipment Lubricants

- .1 Install food grade lubricants for all equipment during storage and prior to initial testing of the equipment.

3. EXECUTION

3.1 SERVICES OF MANUFACTURER

- .1 Inspection, Start-up, and Field Adjustment: Where required by individual Sections, an authorized, experienced, and competent service representative of the Manufacturer shall visit the Site for a minimum of five (5) days to witness or perform the following and to certify in writing that the equipment and controls have been properly installed, aligned, lubricated, adjusted, and readied for operation.
 - .1 Installation of equipment.
 - .2 Inspection, checking, and adjusting the equipment and approving its installation.
 - .3 Start-up and field testing for proper operation, efficiency, and capacity.
 - .4 Performing field adjustments during the test period to ensure that the equipment installation and operation comply with requirements.
- .2 Instruction of the City's Personnel
 - .1 An authorized training representative of the Manufacturer shall be available On-Site as specified in **Section 01650 – Equipment Installation** to instruct the City's personnel in the Operation and Maintenance (O&M) of the equipment, including step-by-step troubleshooting with necessary test equipment. Instruction shall be specific to the models of equipment provided.
 - .2 The Representative shall have at least five (5) years experience in training.
 - .3 Training shall be scheduled four (4) weeks in advance of the session.
 - .4 Proposed training material and a detailed outline of each lesson shall be submitted for review. Review comments from the Contract Administrator shall be incorporated into the material.
 - .5 The training materials shall remain with the trainees after the session.
- .3 Vibration Monitoring: Conduct equipment testing to ensure the operating equipment torsional and vibration measurements meet the acceptable limits. A written report documenting all the test results shall be submitted prior to issuing **Form 103**. Any equipment not within the specified limits shall be repaired.

EQUIPMENT GENERAL PROVISIONS

3.2 Field Tests

- .1 Where indicated by the individual equipment Sections, equipment shall be field tested after installation to demonstrate satisfactory operation without excessive noise, vibration, or no overheating of bearings or motor.
- .2 The following field testing shall be conducted:
 - .1 Start equipment, check, and operate the equipment over its entire operating range. Vibration level shall be within the amplitude limits as indicated or as recommended by the reference applicable Standards.
 - .2 Obtain concurrent readings of motor voltage, amperage, capacity, vibration, and bearing temperatures.
- .3 In the event that any equipment fails to meet the test requirements, the equipment shall be modified and retested until it satisfies the requirement.

END OF SECTION

PROCESS MOTORS

1. GENERAL

1.1 Work Included

- .1 Supply, verification of the On-Site equipment installation, testing, and commissioning of two (2) electric motors.
- .2 The installation of the motor is to be undertaken by the Installation Contractor.

1.2 Submittals

- .1 Shop Drawings: Submit with the related item of process equipment in accordance with **Section 01300 – Submittals**. In addition, submit the following details:
 - .1 Submit the efficiency and power factor information at 100% and 75% load for each motor size and type required.
 - .2 Submit the uncorrected motor power factor for the 25%, 50%, 75%, and 100% of the motor load. Indicate the maximum to which the motor power factor can be corrected, and the KVAR required to accomplish this correction by means of capacitors. The power factor correction shall be recommended by the motor manufacturer.
 - .3 Submit parameter settings for reduced voltage starter.
 - .4 Submit number of permitted starts per hour for this application.
- .2 Operating and Maintenance (O&M) Data: Provide with the related item of process equipment for incorporation in the O&M Manual as specified in **Section 01730 – Operation and Maintenance Manuals**.

1.3 Acceptable Manufacturers

- .1 General Electric.
- .2 Toshiba.
- .3 Westinghouse.
- .4 Siemens.
- .5 U.S. Electric.

1.4 Coordination

- .1 Ensure motor is compatible with all anticipated loads and equipment operating conditions.

PROCESS MOTORS

2. PRODUCTS

2.1 Exposure Classification

- .1 The exposure classification for each motor is specified with the related equipment.
- .2 Motors shall be totally enclosed fan-cooled (TEFC).

2.2 Motors - High Efficiency

- .1 Use high efficiency motors for all services.
- .2 Provide horizontal solid shaft, squirrel cage induction type high efficiency motors, with non-hygroscopic windings. Insulation rate shall be minimum Class F. TEFC motors shall have a service factor rating of 1.15.
- .3 Use Electrical and Electronic Manufacturer's Association of Canada (EEMAC) Design B speed torque characteristics as standard. If higher speed-torque characteristics is required for the driven equipment, use EEMAC Design C or D, as required.
- .4 Provide motors nameplate rated for 4160 V, 60 Hz, 3 phase service unless otherwise specified.
- .5 Where the Contractor has the option to supply variable frequency drives (VFDs) and chooses to supply VFD's, the motors shall be rated for inverter duty.
- .6 Motors shall be suitable for full voltage starting. Voltage tolerance shall be to American National Standards Institute (ANSI) C84.1-1982[2] or +10% to -10% of nameplate voltage. Motors with a service factor of 1.15 shall be designed to operate their driven equipment at a service factor of 1.0.
- .7 Provide motors of sufficient capacity to operate the driven load and associated devices under all conditions of operation without overloading. They shall not be smaller than the kW rating shown on the equipment specification sheets unless approved by the Contract Administrator after review by the Contract Administrator of complete documentation submitted by the Contractor.
- .8 Provide adequately sized, diagonally split, gasketed, EEMAC 4 terminal boxes complete with threaded hub for conduit entry.
- .9 Bearings for the motors shall be extra heavy duty anti-friction type, designed and constructed to provide a running lifetime of one hundred thousand (100,000) hours according to the requirements of the Anti-Friction Bearing Manufacturers Association (AFBMA). Bearings for motors less than 37 kW to be sealed ball bearing type. Bearings on 37 kW to 75 kW motors to be greasable ball bearing type. Greater than 150 kW, bearings with oil lubrication system.

PROCESS MOTORS

- .10 The bearings shall be so designed that no oil or grease can escape from them. Lubrication shall be adapted to the operation of the units without full-time attendance. The type of lubricant required shall be indicated in the operating manuals supplied under this Contract. Both front and rear bearings shall be insulated to prevent damage by shaft currents and shall be equipped with a removable shorting bar so that the insulation can be tested.
- .11 Provide a ground connection and lifting eyes or lugs.

2.3 Painting

- .1 All motors are to be factory painted as specified in **Section 11901 – Factory Applied Maintenance and Corrosion Protective Coatings**.

2.4 Mounting

- .1 All motors are to be supplied integrally with the related equipment.
- .2 Motors are to be factory aligned and balanced with the related equipment to minimize vibration and undue stresses.

2.5 Thermal Protection

- .1 The motor bearings and each motor winding phase shall be equipped with a tip sensitive, 3 wire, 100 ohm at 0°C platinum Resistance Temperature Detector (RTD). Motor windings shall be furnished with two (2) RTDs per phase embedded in the stator winding. Each RTD shall be provided with an integral loop powered 4 to 20 mA output transmitter, refer to **Division 17** for Specifications.

2.6 Vibration Protection

- .1 Motors shall be equipped with vibration monitoring sensors. The sensors shall provide a 4 to 20 mA output signal. Refer to **Division 17** for Specifications.

2.7 Motor Test

- .1 Tests on motor shall be performed at the factory before shipment.
- .2 Each motor shall be subjected to a standard production test in accordance with the Institute of Electrical and Electronic Engineers (IEEE) 112A and EEMAC 1-20.46 and 1-20.47 including:
 - .1 No load amperes.
 - .2 No load watts.
 - .3 Current balance.
 - .4 Winding resistance.

PROCESS MOTORS

- .5 High potential.
- .6 Locked rotor current.
- .7 Vibration.
- .3 A report on the factory tests shall be provided and shall include details of tests undertaken and the test results. Inform the Contract Administrator three (3) weeks prior to factory testing of the motor(s) to allow for his attendance.
- .4 The test report shall be certified by the equipment manufacturer and shall be forwarded to the Contract Administrator and accepted by him before the equipment is released for shipment.
- .5 The report shall be included in the O&M Manual required under Clause 1.2.2.
- .6 Test documentation shall include a complete set of test data and associated curves, including starting characteristics and time-current and thermal limit curves for each machine, showing values measured for that machine.

3. EXECUTION

3.1 Manufacturers Representative

- .1 All motors are to be supplied as an integral component of the raw water pumps. The Manufacturer's Representative for that equipment shall be responsible for the verification of the on-site equipment installation, site testing, and commissioning of the motor as part of the equipment as specified in other Sections. The Manufacturer's Representative for the motor shall inform both the Representative for the pump equipment and the Installer of requirements for the motor, installation, testing, and commissioning.

3.2 Installation

- .1 Refer to **Section 01650 – Equipment Installation**.

3.3 Testing and Commissioning

- .1 Attend a minimum of five (5) days for testing and commissioning of each motor and ensure they operate as intended with its associated pump and variable speed drive.
- .2 Refer to **Section 01650 – Equipment Installation**.

END OF SECTION

PROCESS PUMP GENERAL REQUIREMENTS

1. GENERAL

1.1 Description

- .1 This Section defines the general requirements for the supply of all pumps required for this project.

1.2 Definitions

- .1 The terms in the Specification generally comply with the definitions of the Hydraulic Institute.
- .2 Definitions:
 - .1 Efficiency: Pump efficiency shall be calculated as the delivered hydraulic power divided by the electrical power at the inlet box of the pump. It shall take full account of mechanical and electrical losses.
 - .2 Performance curve: The performance curve is a graph of the flow delivered (L/s; x-axis) in relation to the discharge head (metres; y-axis). It generally denotes efficiencies as isopleths and may include net positive suction head (NPSH) requirements as a function of the flow.
 - .3 Best Efficiency Point (BEP): The BEP is the point in the pump performance curve where the pump operates at its highest efficiency.
 - .4 Rating Point: The pump rating point is the combination of discharge head and flow which the pump must satisfy. It typically is determined on the basis of all duty pumps (one (1) or more, depending on the service) operating simultaneously against the worst system conditions (typically maximum headloss, minimum suction head, maximum discharge head, etc.). This condition is listed in the detailed pump Specification and must be satisfied by the pump supplied.
 - .5 Low Head Point: The low head point is the combination of head and flow which corresponds to the least head the pump might operate against. It is determined on the basis of only one (1) duty pump operating against the system conditions which would produce the least discharge pressure (typically minimum headloss, maximum suction head, minimum discharge head, etc.). The minimum system head is shown or described for each pump. The Manufacturer must ensure that the pump can operate satisfactorily, without cavitation in the pump casing or over-stressing of the motor, at the intersection of the pump curve and the minimum head curve, or low head point.
 - .6 Low Speed Point: The minimum flow and head conditions against which a variable speed pump is expected to operate.
 - .7 NPSH: The total pressure (atmospheric) at the pump suction. The available NPSH is the pressure available at the pump suction and is a function of Site atmospheric pressure

PROCESS PUMP GENERAL REQUIREMENTS

and suction piping losses. Required NPSH is the pressure required at the pump suction to ensure cavitation due to water column separation does not occur. Required NPSH shall be indicated by the Contractor at the pump inlet connection whether that be at the casing or at the face of a suction reducer/elbow supplied as an integral part of the pump.

1.3 Submissions

- .1 Shop Drawings: Submit in accordance with **Section 01300 – Submittals** and **11000 – Equipment General Provisions**. For all pump Shop Drawings in addition to the requirements of **Section 11000 – Equipment General Provisions**, include the following specific details:
 - .1 Performance curve for the pumping unit(s) superimposed on the system curve for the particular pumping application. With the performance curve, include efficiency isopleths and NPSH Required (NPSHR) variation with flow. Where required in the specific pump Sections, the performance curve should be certified in accordance with Hydraulic Institute Standards.
 - .2 Motor operating data, including motor and insulation ratings, start-up and operating current ratings, operating voltage and amperage tolerances, description of construction complete with illustrative Drawings, and any other pertinent information.
 - .3 List of materials of construction, detailing the component parts of the pump(s), their materials of construction, and reference Specifications for those materials.
 - .4 Required ancillary services including but not limited to electrical, seal water, and drains. The sizes, ratings, and any other pertinent information related to these services.
 - .5 Installation instructions indicating assembly and mounting requirements, alignment and assembly tolerances, and points of connection for ancillary services (electrical, seal water, drains, etc.).
 - .6 Start-up instructions including lubricant requirements, electrical requirements, etc.
- .2 Operating and Maintenance (O&M) Data: Provide for incorporation in O&M Manual as specified in **Section 01730 – Operations and Maintenance Manuals**. Include the following:
 - .1 Complete description of operation.
 - .2 General arrangement and detailed Drawings.
 - .3 Wiring diagrams for power and control schematics.
 - .4 Parts catalogues with complete list of repair and replacement parts with Section Drawings, illustrating the connections and the part Manufacturer's identifying numbers.

PROCESS PUMP GENERAL REQUIREMENTS

1.4 Delivery and Storage

- .1 Prior to delivery, ensure that the Certificate of Readiness (**Form 101**) is completed to ensure that the Installation Contractor is ready to receive the specified equipment.
- .2 Ship pre-assembled to the degree that is possible. Inform Installation Contractor of any Site assembly requirements.
- .3 Securely fasten heavy wood blanks to the pump flanges. Use blanks that are larger diameter than the flange. Protect machined surfaces against rusting. Protect threaded connections with threaded plugs or caps. Protect open, plain pipe ends with caps.
- .4 Where pumps are to be stored On-Site for any period of time exceeding one (1) week, instruct Installer of specific requirements to ensure there is no uneven wear or distortion of pump component parts.
- .5 Identify any special storage requirements.

1.5 Coordination

- .1 Coordinate with other Divisions to ensure there are no conflicts in the Work.

2. PRODUCTS

2.1 Pump Performance Requirements

- .1 Supply pumps that are suitable for continuous duty.
- .2 Select impellers for fixed speed pumps that permit operation at an efficiency of within 5% of the efficiency at the BEP.
- .3 For variable speed pumps, select pump speed and impeller diameter which allow operation from the Rating Point to the Low Speed Point at efficiencies within 10% of efficiency at the BEP.
- .4 Ensure that motors are sufficiently sized to drive pumps at a maximum speed when the head is for the high head point as specified in **Section 11320a – Detailed Pump Specification**.

2.2 Pressure Sensing

- .1 Supply a means of measuring inlet and outlet pressure with each pump, except as noted.
- .2 For vertical pumps handling raw water, supply gauges for mounting on the suction column and discharge head of the pump.
- .3 For centrifugal pumps handling clean water, supply gauges for the inlet and outlet of each pump.

PROCESS PUMP GENERAL REQUIREMENTS

- .4 For submersible pumps, supply only one (1) gauge for mounting on the discharge of the pump on a weldolet installed outside, but within 2 m of the wet well.
- .5 Gauges
 - .1 Supply gauges that are 60 mm diameter, 6.35 mm bottom connection, complete with shut off cock with stainless steel movement and Bourdon tube.
 - .2 Use metric units of measurement (kPa or Pa), clearly indicated on the face of the gauge.
 - .3 Calibrate the gauges to read pressure ranges approximately as follows:

| | Actual Pressure | Gauge Pressure Range |
|-----------|------------------------|-----------------------------|
| Suction | -50 to 50 kPa | -50 to 350 kPa |
| | 50 to 200 kPa | 0 to 350 kPa |
| | 200 to 700 kPa | 0 to 1000 kPa |
| Discharge | 50 to 350 kPa | 0 to 700 kPa |
| | 350 to 700 kPa | 0 to 1000 kPa |
| | 700 to 1500 kPa | 0 to 2000 kPa |

- .4 Approved Manufacturers: Ashcroft, H.O. Trerice.

2.3 Pump Seals

- .1 Provide single mechanical seals unless otherwise noted in the Specifications of the particular pump.
- .2 Double mechanical seals can be used unless otherwise noted in the Specifications of the particular pump.
- .3 Double mechanical seals are located adjacent to one another, with a cooling/flushing water filled space between. They are supplied as a single package.
- .4 Provide non-destructive, self aligning seals of the stationary design which require no wearing sleeve for the shaft.
- .5 Materials of construction:

| Type of Service | Metal Parts | Spring(s) | O-Rings | Faces |
|------------------------|--------------------------------|-----------------------|--------------------|------------------------------|
| Potable water. | 316 or 317L Stainless Steel | 316 or Hastelloy C | Buna-N or Viton | Silicon Carbide on Carbon |

- .6 Provide connections for cooling/flushing water.

PROCESS PUMP GENERAL REQUIREMENTS

.7 Approved Manufacturers are:

- .1 Durametallic.
- .2 John Crane.
- .3 Chesterton.

2.4 Packing

- .1 Packing can be used only where noted in the Specifications of the particular pump.
- .2 Provide a minimum of five (5) rows of packing material suitable for the medium being pumped.
- .3 Provide bronze lantern rings that are externally adjustable.

2.5 Stuffing Boxes

- .1 Integrally cast the stuffing box with the motor mounting bracket, providing adequate area for the internal recirculation of the flushing/cooling fluid around the sealing medium.
- .2 Provide a tapped and plugged hole for external flushing/cooling water.

2.6 Bearings

- .1 Refer to **Section 11000 – Equipment General Provisions**.

2.7 Protective Guards

- .1 Provide a protective guard for all couplings and keys, drive belts, or other exposed rotating devices. As a minimum, conform to the requirements of **Section 11000 – Equipment General Provisions**.

2.8 Couplings

- .1 For all pumps other than submersible and where noted otherwise in the detailed Specifications, provide flexible, double disc spacer type couplings conforming to **Section 11000 – Equipment General Provisions**.
- .2 Design couplings so that the pump unit can be disassembled without disturbing face piping.

2.9 Shafts

- .1 Design shafts to absorb 1.15 times the rated power of the motors required to drive the pumps when the pump is fitted with maximum size impellers.

PROCESS PUMP GENERAL REQUIREMENTS

2.10 V-Belt Drives

- .1 Do not use V-belt drives unless specified or shown on the Drawings.
- .2 Conform to the requirements of **Section 11000 - Equipment General Provisions**.
- .3 Where V-belt drives are indicated, ensure that the pump motor can handle operating speeds 20% higher than required for the specified operating points.

2.11 Tagging Instructions

- .1 Tag loose items associated with a particular unit with the equipment number. Use aluminum or stainless steel (no plastic) tags securely attached to each item.
- .2 Identification used shall be the same as the symbol indicated in the Specifications or on the Drawings and shall be located in a conspicuous place as acceptable to the Contract Administrator.

2.12 Spare Parts

- .1 For each pump, provide spare parts as indicated in **Section 11320a – Detailed Pump Specification**.

2.13 Factory Performance Testing

- .1 Each pump assembly as noted in the Sections related to pumps shall be factory performance tested.
- .2 Factory testing shall involve testing the pump assemblies in accordance with the performance requirements as specified in **Section 11320a – Detailed Pump Specification**.
- .3 Conduct factory performance testing in compliance with the Hydraulic Institute Standards.
- .4 At a minimum, the tests shall provide pump characteristics curves showing:
 - .1 Head and flow readings at not less than five (5) capacity points at maximum speed including:
 - .1 Shut-off;
 - .2 Run-out;
 - .3 Duty point; and
 - .4 At least two other points.
 - .2 Pump efficiency over the entire range.

PROCESS PUMP GENERAL REQUIREMENTS

- .5 Inform Contract Administrator at least three (3) weeks prior to the factory testing to allow for his attendance.
- .6 Certify test results and summarize findings in a short report. Submit report to the Contract Administrator within three (3) weeks of completing factory tests.
- .7 Where the pump(s) does not satisfy the specified performance requirements within the tolerances specified by the Hydraulics Institute, redesign, modify, and re-test the pump(s), all at no additional cost.
- .8 Do not ship the pump(s) until the test result report has been submitted to the Contract Administrator.

2.14 Finishes

- .1 Factory prime and finish all pumps in accordance with **Section 11901 – Factory Applied Maintenance and Corrosion Protection Coatings**.

3. EXECUTION

3.1 General

- .1 Comply with the requirements of the specific Sections for the pumps to be provided.

3.2 Installation

- .1 Installation of the Deacon booster pumps and ancillary equipment will be performed by the Installation Contractor under a separate contract.
- .2 The Supply Contractor shall comply with the requirements of **Section 01650 – Equipment Installation** and any special requirements listed in the specific Sections related to each pump.

3.3 Testing

- .1 Field test all pumps greater than or equal to 3.7 kW, and smaller units where noted, to verify performance.
- .2 Field testing will be conducted by the Installation Contractor and shall be verified by the Contractor.
- .3 Provide temporary connections, flow monitoring, pressure monitoring, ammeters, and temporary tankage required for the performance of the tests.

PROCESS PUMP GENERAL REQUIREMENTS

.4 Flow Metering

- .1 Where possible, use fill and draw techniques to determine the amount of flow conveyed during the test period. Ensure that the volumes are sufficient for at least five (5) minutes of pump operation at the flows that are to be tested, other than runoff.
- .2 Where permanent flow meters are installed on the downstream piping, they may be used to measure the flow during testing when accepted by the Contract Administrator. Ensure that the permanent flow meters are calibrated to within 5% of the rated flow of the pump to be tested prior to testing.
- .3 Temporary metering may be used if accepted by the Contract Administrator. Temporary meters must have an accuracy of plus or minus 5%, at the rated flow of the pump, to be acceptable.
- .4 Where other methods are not possible or where directed, use dye testing to determine the flow during the test periods. Dye testing is to be conducted by an agency acceptable to the Contract Administrator. Measured flows during the testing will be certified by a qualified Representative of the Contract Administrator to be within 5% of the actual flows.

.5 Pressure Monitoring

- .1 Do not use permanent gauges for pressure monitoring during tests. Temporary test gauges can be connected to the permanent gauge taps.
- .2 Use gauges with sufficient accuracy to measure anticipated pressures on pump discharges within 2.5%. Where pump suction draws from an open tank or wet well, test gauge must be capable of measuring pressure at pump suction within 1.0 kPa.
- .3 Provide evidence of pressure gauge calibration within three (3) months of conducting tests.
- .6 Test pump(s) at a minimum of three (3) flow conditions, typically corresponding to the rating point flow, 75% of that flow, and 120% of that flow. At each test point, measure flow, pressure, and amperage. In addition, verify run-out conditions.
- .7 For variable speed pumps, conduct the tests at two (2) speeds, typically 100% of the design speed and 70% of the design speed.

.8 Field Test Report

- .1 Compile field test results into a report for submittal to the Contract Administrator.
- .2 Describe test set-up and measurement devices used to conduct the tests.

PROCESS PUMP GENERAL REQUIREMENTS

- .3 For each pump, list the specified performance requirements and field test results. Show field test results (flow, pressure, power draw) superimposed on the performance curve provided with the submissions.

- .9 Where field tests do not verify compliance with specified performance requirements; investigate cause for noncompliance, undertake remedial Work as required to bring pump into compliance or replace the pump and all necessary ancillaries, and retest to prove compliance. All Work required to bring the pump into compliance is the responsibility of the Contractor and will be performed at no extra cost to the City.

END OF SECTION

PROCESS PUMPS HORIZONTAL CENTRIFUGAL PUMPS

1. GENERAL

1.1 Work Included

- .1 The supply, verification of the On-Site equipment installation, testing, commissioning, and training of two (2) horizontal, split case centrifugal pumps for pumping treated water.

1.2 Submissions

- .1 Shop Drawings: Submit in accordance with **Section 01300 – Submittals**.
- .2 The Shop Drawings shall provide, at a minimum, the following information:
 - .1 Pump performance characteristic curves, which includes: total developed head, brake horsepower, required submergence, efficiency, and net positive suction head (NPSH) curves. Total developed head and pump efficiency shall include the pump suction and discharge head losses, and the velocity head at the discharge nozzle.
 - .2 Dimension of each pump component including case, suction and discharge flanges, motor, and frame.
 - .3 Weight of each principal pump component.
 - .4 Material specifications for each component.
 - .5 Details of pump seals, bearings, and details of external water lubrication flow if required.
 - .6 Pump set inertia including pump, shaft and motor.
- .3 Operating and Maintenance (O&M) Data: Provide for incorporation in to the O&M Manual as specified in **Section 01300 – Submittals**. Include complete description of operation together with general arrangement and detailed Drawings, wiring diagrams for power and control schematics, parts catalogues with complete list of repair and replacement parts with section Drawings, illustrating the connections, and identifying numbers.

1.3 Delivery and Storage

- .1 Ship pre-assembled free on board (FOB) Site.
- .2 Identify special storage requirements in addition to those of **Section 01650 – Equipment Installation**.

1.4 Coordination

- .1 Coordinate with other Divisions to ensure there are no conflicts in the Work.

PROCESS PUMPS HORIZONTAL CENTRIFUGAL PUMPS

2. PRODUCTS

2.1 Pump Schedule

- .1 Specific pumps to be supplied are listed in **Section 11320a – Detailed Pump Specification**. The supply of the horizontal split case centrifugal pumps shall come from only one (1) single Manufacturer.

2.2 Pump Performance

- .1 The pump performance shall be as described as follows and in **Section 11320a – Detailed Pump Specification**. The pump head/discharge characteristic shall provide a continuously falling curve throughout the pump range so that only one (1) flow rate is possible for a specific total discharge head.
- .2 The total maximum output (design peak hour rate), when two (2) pumps are operating at full speed, shall be 3,240 L/s at design system head characteristics. The pump proposed shall be capable of operating satisfactorily on its own as well as in parallel operation with other pumps. Each pump shall also be capable of operating through the range of conditions defined by the attached system head curves.
- .3 When the new pump is operating on its own rather than in parallel with any other pumps, it will be desirable to select the pump such that it will operate slightly to the right of its best efficiency point at maximum speed. As the pump will be variable speed, running against a relatively flat system head curve at less than maximum speed will back the pump up the performance curve into its best efficiency point (BEP).
- .4 The pump shall be capable of operating satisfactorily at speeds as low as 70% of maximum speed.
- .5 The pump efficiency shall not be less than 80% at the duty condition at full speed.

2.3 Pumps

- .1 The pump shall be single stage, double suction, horizontal split case centrifugal pump with side suction connection. The suction and discharge connections shall be located in the pump lower casing to facilitate the removal of rotating elements without the need to dismantle the piping connections.
- .2 Any unspecified materials shall be selected specifically for their suitability in meeting the duty requirements. Casting shall be free from flaws and imperfections and machined surfaces finished true.
- .3 Inside and outside corners and edges of all casings shall be rounded off. Bolts and nuts shall have an acceptable means to prevent them from becoming loose (pins, spring or friction washered fasteners). No patching, plugging, shimming or other means of overcoming defects, inconsistencies or errors shall be used without the written approval of the Contract Administrator.

PROCESS PUMPS HORIZONTAL CENTRIFUGAL PUMPS

- .4 The pump will operate under conditions of flooded suction at start-up. Positive static suction head on pumps will vary due to varying supply reservoir levels.

2.4 Pump Setting

- .1 The Contractor shall ascertain and confirm the exact pump assembly length, which shall also comply with the general details shown on the Drawings.
- .2 The pump, motor, and variable speed drive (VSD) shall be mounted on a common frame and shall fit into the allotted space in the Deacon Booster Pumping Station (DBPS).

2.5 Pump Cases

- .1 The pump cases shall incorporate bolted connections.
- .2 Pump cases shall be designed for an internal pressure exceeding either two (2.0) times the pumpset maximum design head or one and a half (1.5) times the pumpset shut-off head, whichever is the greater.
- .3 The casing shall be of ample thickness and rigidity and provided with reinforcing ribs, where necessary, to withstand all stresses resulting from continuous operation.
- .4 The upper and lower half casings shall be furnished with heavy flanges, faced drilled and bolted together. The arrangement shall be such that it permits easy removal and accurate replacement of the upper casing for inspection and maintenance. The bearing brackets shall be cast as an integral part of the lower casing.
- .5 The upper pump casing shall be fitted with lifting rings to facilitate its removal or for lifting the entire pump unit.
- .6 The lower pump casing shall be provided with mounting feet for bolting and dowelling to the base plate.
- .7 Casing shall be provided with 19 mm NPT tapped openings for air release and drainage connections.
- .8 Materials shall be:
- .1 Case: cast iron, ASTM A48 Clause 35 or better.
- .2 Bolts and nuts: stainless steel, AISI 316 ASTM A193 Grade B8M Class2.
- .9 Provide pump case wear rings for the front and back of the impeller location for each pump. Materials shall be 400 series stainless steel.
- .10 The pump case shall be epoxy-coated internally and externally in accordance with American Water Works Association (AWWA) C210-97 – Liquid Epoxy Coating Systems for the

PROCESS PUMPS HORIZONTAL CENTRIFUGAL PUMPS

Interior and Exterior of Steel Water Pipelines, minimum total dry film thickness of 406 μ and two (2) coats.

2.6 Suction and Discharge Connections

- .1 Suction and Discharge nozzles shall be integral to the casing, be 180° apart, and shall have the same centerline axis.
- .2 Suction and discharge connections shall be flanged, faced and drilled to conform to American National Standards Institute (ANSI) #125. These connections shall be sized to minimize hydraulic friction losses turbulence and pipe noise.
- .3 Gauge connections, tapped for 9.5 mm NPT pipe, shall be provided on the suction and discharge nozzles close to the flanges. Brass shut-off cock shall be connected to each gauge tap and shall be provided and fitted in the factory.

2.7 Pump Shaft

- .1 Fabricate pump shafts of American Iron Steel Institute (AISI) class 400 stainless steel or equivalent and accurately machined and ground over its entire length.
- .2 Make the shaft of sufficient diameter to assure rigid support of the impeller and to transmit loads without slip, vibration or undue deflection at operating loads. Where L = impeller overhang and D = shaft diameter, maintain $L^3/D^4 < 80$.
- .3 Key the impeller to the shaft, and secure by an impeller bolt. Design the assembly to prohibit loosening of the connection due to torque developed during operation. Design the assembly to allow a smooth flow path.
- .4 Provide a renewable shaft sleeve to protect the shaft through the sealing box area.

2.8 Shaft Sleeve

- .1 The shaft sleeves shall be fabricated from type 316 stainless steel and shall be cleaned and de-scaled in accordance with American Standards for Testing and Materials (ASTM) A380. Sleeves shall be hard coated to 450 BHN hardness.
- .2 The shaft sleeves shall be used to protect the shaft and shall extend from the impeller hub through the stuffing boxes. The sleeves shall be keyed to the shaft to prevent rotation and properly fitted to ensure alignment through the stuffing box and shall be sealed to prevent leakage between the sleeves and the shaft. They shall be turned to a suitable contour at the impeller hub to ensure a smooth flow of liquid into the impeller inlet.

2.9 Wearing Rings

- .1 The casing and impeller shall be fitted with removable wearing rings. These rings shall be designed and machined for a close fit for maximum pump efficiency to minimize leaking of

PROCESS PUMPS HORIZONTAL CENTRIFUGAL PUMPS

fluid. The rings shall be secured in such a way as to allow for ready replacement and to prevent loosening under normal operation or under reverse pump rotation.

- .2 Wearing rings shall be fabricated from stainless steel 400 series conforming to ASTM A296. The impeller ring hardness shall not be less than 300 Brinell. The casing ring hardness shall exceed the impeller ring hardness by not less than 50 Brinell.

2.10 Impellers

- .1 The impeller shall be of the enclosed, double suction type. The vanes shall be of similar form and evenly spaced. The impeller shall be both statically and dynamically balanced to prevent vibration and shall be keyed to the shaft and held in position by shaft sleeves secured by shaft nuts. The shaft nuts shall be bronze conforming to ASTM B505. The assembly of the impeller and shaft shall be so designed and constructed that the impeller shall not become loosened from torque resulting from rotation.
- .2 The impellers shall be carefully machined and polished to a smooth finish.
- .3 The impeller shall be smooth contoured and of one (1) piece nickel-aluminum bronze conforming to ASTM B148-C95800.

2.11 Bearings

- .1 Pump bearings shall be of heavy duty, single row or double row, anti-friction type ball bearings arranged for oil or grease lubrication. Bearings shall be arranged for radial and axial thrusts.
- .2 Inboard and outboard bearings of the pump shall be interchangeable. Bearings shall be designed for a B-10 life of not less than one hundred thousand (100,000) hours in accordance with Anti-Friction Bearing Manufacturers Association (AFBMA) without the addition of external cooling.
- .3 Lubrication shall be designed for operation with minimum maintenance. Type of lubricant recommended shall be indicated in the O&M Manuals provided.
- .4 Removeable bearing housing shall be bolted and accurately positioned to bearing bracket in the lower pump casing to ensure alignment.

2.12 Stuffing Box and Packing

- .1 Stuffing box shall be machined into the casing and so arranged that leakage will be reduced to a minimum without excess friction between the packing and shaft sleeves. Means shall be provided for piping leakage to drain.
- .2 Stuffing box shall be equipped with a bronze lantern ring and a water connection for flushing.

PROCESS PUMPS HORIZONTAL CENTRIFUGAL PUMPS

- .3 Stuffing box shall contain an integral bushing and designed to accommodate five (5) rows of packing. The packing shall be contained by a gland secured with stainless steel studs and nuts. The gland shall be split to allow its removal without disturbing other parts of the pump. Ample room shall be allowed around the gland for such removal and repacking.
- .4 Acceptable Product: John Crane, C1065.

2.13 Base Plate

- .1 The pump, motor and VSD coupling shall be mounted on a common one piece fabricated steel plate with provision to collect leakage. The base plate shall be of sufficient thickness and rigid design to resist torsional movement and to support the whole weight of the pump assembly. Base plate shall be designed such that it can be grouted to eliminate vibration.
- .2 Plate material shall conform to ASTM A36. No member shall be less than 6 mm thick and the total weight of the base plate shall be at least 20% of the total weight of the entire pumping unit. Design calculations of the base plate shall be submitted with the Shop Drawings for review.
- .3 If base plate is to be used for factory pump testing, consideration shall be given to stiffening the plate in order to accommodate the factory test conditions.
- .4 The Contractor shall ensure the accuracy of the bolt hole size and locations required. Separate pieces to be welded onto or re-drilling the base plate later On-Site shall not be permitted.

2.14 Driver

- .1 The electric motor drivers shall conform to the requirements of **Section 11200 – Process Motors** and **Section 11320a - Detailed Pump Specification**. Motors shall be of high efficiency and shall meet the Manitoba Hydro's minimum requirements for eligibility for motor capital cost rebate.

2.15 Spare Parts

- .1 Provide spare parts as indicated in **Section 11320a – Detailed Pump Specification**.

3. EXECUTION

3.1 Manufacturer's Representative

- .1 Manufacturer's Representative shall be required to attend installation and Performance Verification as specified in **Section 01650 – Equipment Installation**.
- .2 A minimum of five (5) days shall be required to verify the on-site equipment installation, On-Site testing and commissioning of the pump systems.

PROCESS PUMPS HORIZONTAL CENTRIFUGAL PUMPS

3.2 Installation

- .1 Ensure that each pump is installed in accordance with the Manufacturer's recommendations and as required to provide satisfactory service.
- .2 Fulfill the requirements for a successful installation as documented by **Form 101**, illustrated in **Section 01650 – Equipment Installation**.

3.3 Testing

- .1 Factory testing of each pump assembly shall be conducted in accordance with **Section 11300 – Process Pump General Requirements**.
- .2 Ensure that each pump, including all component parts, operates to meet the requirements specified in **Section 11300 – Process Pump General Requirements**, and the performance requirements specified in **Section 11320a – Detailed Pump Specification**.
- .3 Fulfill the requirements for a successful testing of the equipment as documented by **Form 102**, illustrated in **Section 01650 – Equipment Installation**.

3.4 Commissioning

- .1 Fulfill the requirements for successful commissioning of the equipment as documented by **Form 103**, illustrated in **Section 01650 – Equipment Installation**.
- .2 Fulfill the requirements for a successful testing of the equipment as documented by **Form 103**, illustrated in **Section 01650 – Equipment Installation**.

END OF SECTION

DETAILED PUMP SPECIFICATION

1. GENERAL DESCRIPTION

1.1 Identification:

- .1 Pump Name – Deacon Booster Pump.
- .2 Equipment Number – To Be Determined
- .3 Quantity - Two (2).
- .4 Location – Deacon Booster Pumping Station (DBPS).

1.2 Operating Conditions: The Work of this Section shall be suitable for long-term operation under the following conditions:

- .1 Duty: Continuous.
- .2 Drive: Variable speed.
- .3 Ambient environment: Indoors.
- .4 Ambient temperature, (°C): 10 to 30.
- .5 Ambient relative humidity (%): 20 to 100.
- .6 Fluid service: Treated Chloraminated Water.
- .7 Fluid temperature, (°C): 1 to 30.
- .8 Fluid pH range: 5.0 to 8.5.
- .9 Fluid specific gravity: 1.0.
- .10 Fluid viscosity (Centipoises @ 20°C): 1.12.
- .11 Fluid viscosity (Centipoises @ 1°C): 1.7.
- .12 Minimum available net positive suction head (NPSH) (m): 11.5
- .13 Clear Well water elevations are as follows:
 - .1 Low – low water level (m): 230.3
 - .2 Low water level (m): 231.0
 - .3 Normal water level (m): 235.35
 - .4 High water level (m): 236.44

DETAILED PUMP SPECIFICATION

1.3 Performance Requirements:

- .1 The Contractor shall confirm that the total combined flow of both duty pumps meet all design flow capacities and their associated heads.
- .2 The speed of the pumps shall be such that no excessive cavitation or vibration occurs throughout the entire operating range. The pumps shall operate at specific speeds within the limits prescribed by the Standards of the Hydraulic Institute. Vibration of the pump/motor configuration shall not exceed the Standards of the Hydraulics Institute.
- .3 The Contractor shall be responsible for proper dimensions, torque and thrust requirements, and the compatibility of the pump, motor, and variable speed drive (VSD) characteristics.
- .4 Minimum design flow capacity (L/s): 2,300 (199 ML/d).
- .5 Minimum design flow pump head (total dynamic head (TDH) m): 7.0.
- .6 Normal design flow capacity (L/s): 2,940 (254 ML/d).
- .7 Normal design flow pump head (TDH m): 13.0.
- .8 Maximum design flow capacity at maximum speed (L/s): 3,240 (280 ML/d).
- .9 Maximum design flow pump head (TDH m): 16.0.
- .10 Minimum pump efficiency for all flow conditions (%): 80.

Note: The system curves have been provided in Figure 11.1 for information purposes.

1.4 Pump Dimensions:

- .1 Suction flange, size (mm) – 900.
- .2 Discharge flange, size (mm) – 600.
- .3 Suction flange rating, American National Standards Institute (ANSI) (psi) – 125.
- .4 Discharge flange rating, ANSI (psi) – 125.

2. PUMP REQUIREMENTS

2.1 Construction: Construction of the horizontal split case centrifugal pumps shall conform to the following requirements:

- .1 Casing, impellers, wearing rings, shafts, sleeves, seals and bearing shall in accordance with **Section 11320 – Process Pumps Horizontal Centrifugal Pumps.**

DETAILED PUMP SPECIFICATION

.2 Pump base - Cast iron or steel base plate with drain rim or pan, coated as per **Section 11901 – Factory Applied Maintenance and Corrosion Protection Coatings.**

2.2 Drive: Heavy duty, horizontal, electric motor suitable for 4160 V, 3 phase, 60-Hz power supply, in accordance with **Section 11200 – Process Motors.** Pump and motor assembly shall be complete with a mechanical VSD in accordance with **Section 11330 – Variable Speed Drives.**

3. PUMP CONTROLS

.1 Pumps shall be controlled in accordance with the Specifications of **Division 17.**

4. SPARE PARTS:

.1 Provide sufficient spare parts and consumable products for one (1) year of continuous operation. At a minimum, the following spare parts shall be furnished for each pump or as otherwise indicated:

- .1 One (1) casing wearing.
- .2 Two (2) sets of all gaskets, seals, and O-rings.
- .3 Stuffing box packing.
- .4 Stuffing box bearing.
- .5 Pump shaft sleeve bearings.
- .6 One (1) casing wearing ring set.
- .7 One (1) impeller.
- .8 One (1) pump shaft
- .9 Any special tools required to dismantle the pump.

5. APPROVED MANUFACTURERS

- .1 Ebara
- .2 Flowserve
- .3 Fairbanks-Morse
- .4 Weir

DETAILED PUMP SPECIFICATION

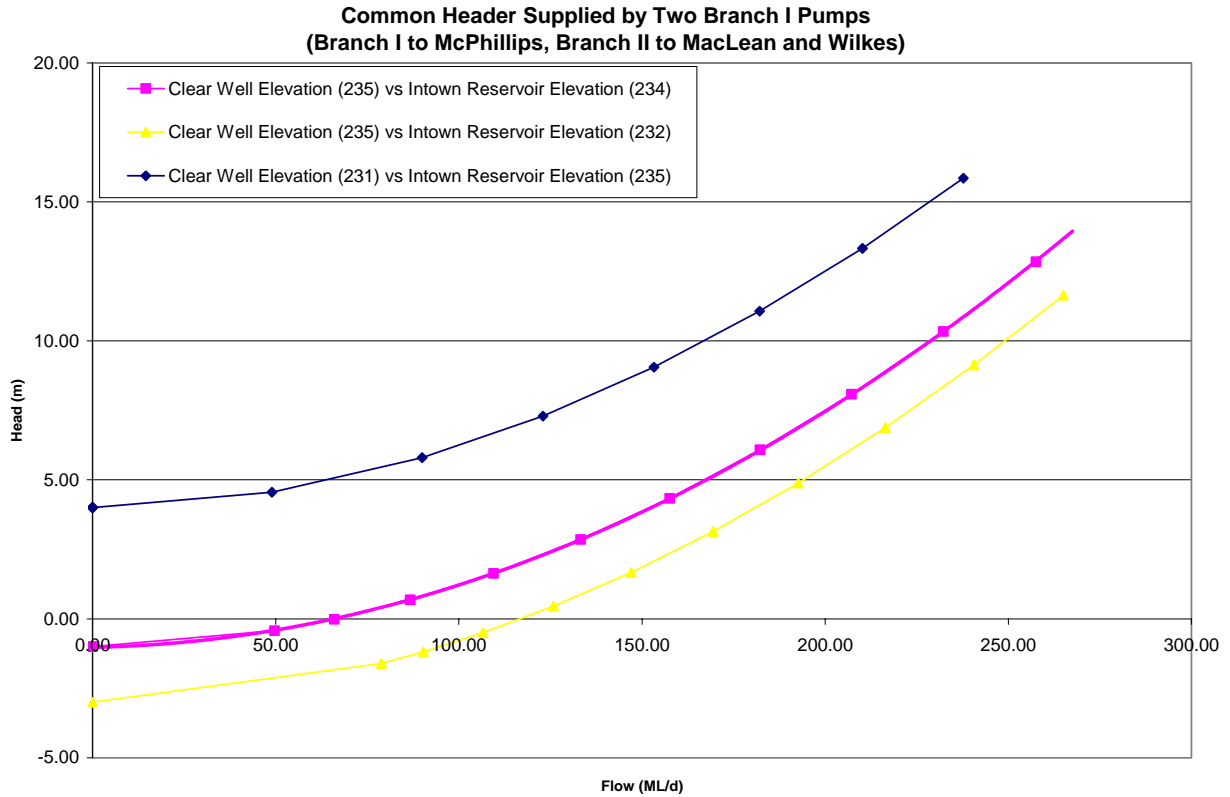


Figure 11.1: System Head Curves

Note: The system curves do not account for friction losses within the suction or the discharge of the pump. These losses shall be determined by the Contractor and added to the above system curves.

END OF SECTION

VARIABLE SPEED DRIVES

1. GENERAL

1.1 Work Included

- .1 Supply, verification of the On-Site equipment installation, testing and commissioning of Variable Speed Drives (VSD).
- .2 The installation of the VSD is to be undertaken by the Installation Contractor.

1.2 Standards

- .1 All VSDs supplied under this Contract shall meet or exceed the following Specifications.
- .2 The adjustable speed controller shall be designed to operate under continuous duty with a standard squirrel cage induction motor with a 1.15 S.F. and a horizontal split case centrifugal pump.
- .3 VSD units shall be Canadian Standards Association (CSA) certified.

1.3 Tests

- .1 Factory testing
 - .1 VSD units are to be factory tested with the pumps and motors prior to shipment. Provide confirmation from factory of actual tests completed and results. Factory testing shall be conducted in accordance with **Section 11300 – Process Pump General Requirements**.
- .2 Field testing
 - .1 The VSD Manufacturer's Representative shall provide On-Site start-up assistance, fine-tuning, and operator training.
 - .2 The VSD Manufacturer's Representative shall provide Site functionality test reports indicating proper installation and operation settings
 - .3 The VSD Manufacturer's Representative shall verify the unit and system performance by demonstrating that the VSD meets the performance requirements as specified in **Section 01650 – Equipment Installation**.
 - .4 Allow for all costs and labour for as many trips as necessary to complete requirements.

VARIABLE SPEED DRIVES

2. PRODUCTS

2.1 Variable Speed Drives

- .1 VSD as supplied by the following acceptable Manufacturer:
 - .1 MagnaDrive Corporation.
- .2 Design Requirements
 - .1 Design and provide VSD systems consisting of a horizontal VSD rotor assembly, actuator assembly, and other components necessary for a complete operating system. The VSD assembly shall include a support assembly for use with horizontal motors and horizontal split case centrifugal pumps.
 - .2 The design of the VSD shall include a cooling system consisting of either air or water. If cooling water is required, the cooling water will be rejected On-Site. As an option, provide circulating water-cooling system details for consideration.
 - .3 Supply the VSD system rated on the basis of peak torque and heat dissipation requirements as determined by actual design load. The motor design speed and peak design load shall be determined by the Contractor when selecting the appropriate pumps.
 - .4 The Contractor shall convert the motor speed to the design operating speed throughout the design range of operation. Peak load speed and the minimum load speed shall be designed to preclude operation above the VSD heat dissipation capacity.
 - .5 The VSD shall be provided with a nonreversible clutch device to prevent reverse rotation of the pump and motor.
 - .6 An electric actuator shall be supplied with each VSD in accordance with Specification **Section 17213 – Powered Actuators**.
 - .7 The VSD shall be designed to accommodate the thrust at the maximum flow Anti-Friction Bearings Manufacturer's Association (AFBMA)-B10 bearing life of forty thousand (40,000) hours.
 - .8 Adjustable shaft couplings shall be used to connect the motor and load shafts and shall be supplied by the Contractor.
- .3 Environmental Capabilities:
 - .1 The drive shall operate without mechanical or electrical damage under any combination of conditions as follows:
 - .1 Ambient temperature: 10 to 30°C.

VARIABLE SPEED DRIVES

- .2 Humidity 20 to 100% (non condensing).
- .3 Vibration up to 0.5 g.
- .4 Altitude 0 to 1250 m.
- .4 Components:
 - .1 At a minimum, the following components shall be included:
 - .1 VSD
 - .1 Air or Water-cooled conductor assembly with plated steel rotor plates and copper or aluminum conductors, and stainless steel fasteners.
 - .2 Alloy steel conductor hub input shaft.
 - .3 Output rotor assembly with anodized aluminum magnet rotors, electroless nickel and tin-plated neodymium-iron-boron magnets, steel hubs and output shaft, and stainless steel fasteners.
 - .4 Air gap adjustment shall be provided by an acme screw actuator gearbox with spherical roller thrust bearing for water-cooled drives or an inner tube assembly with rack and pinion or centre pivot for air cooled drives.
 - .5 Powder coated steel housing assembly.
 - .6 Coolant flow and outlet temperature protective controls for water cooled drives.
 - .7 Oil flooded lubricated gearbox/bearing housing (water cooled) with bearing temperature controls. Force feed lubrication will not be accepted.
 - .2 Actuator Assembly
 - .1 Provide actuator assembly capable of regulating drive air gap.
 - .2 The actuator shall be in accordance with **Section 17213 – Powered Actuators**.

2.2 Spare Parts

- .1 Provide one set of seals for each VSD supplied.
- .2 Provide replacement lubricating oil for each VSD.

VARIABLE SPEED DRIVES

3. EXECUTION

3.1 Operations and Maintenance Manual

- .1 The Contractor shall provide at a minimum, the following data:
 - .1 Overall VSD system operating data, including efficiency at the rated load and speed.
 - .2 VSD installation, Operations and Maintenance (O&M) Manual.
 - .3 Overall actuator operating data.
 - .4 Actuator installation, O&M manual.
 - .5 VSD and actuator dimensional general arrangement Drawings.
 - .6 Itemized bill of materials listing all system components.
- .2 Installation
 - .1 Provide all relevant information to the Installation Contractor regarding mounting requirements including concrete pads for all floor mounted equipment. Complete **Form 101** as illustrated in **Section 01650 – Equipment Installation**.
 - .2 Inspect VSD for proper installation and operation settings and complete **Form 102** as illustrated in **Section 01650 – Equipment Installation**. Record inspection results data and append to **Form 102**.
 - .3 Perform functional test on each VSD as identified in Clause 1.3 and complete **Form 103** as illustrated in **Section 01650 – Equipment Installation**. Record test data and append to **Form 103**.
- .3 Field Quality Control
 - .1 The Contractor shall be responsible for the testing and commissioning of each VSD as specified in **Section 01650 – Equipment Installation** and to the satisfaction of the Contract Administrator and the City. The Contractor shall allow for a Manufacturer's Representative to completely calibrate all drives after installation On-Site.

END OF SECTION

FACTORY APPLIED MAINTENANCE AND CORROSION PROTECTION COATINGS

1. GENERAL

1.1 Work Included

- .1 Supply and application of all factory applied prime coats and factory applied finish coats.

1.2 Submissions

- .1 With the equipment Shop Drawings, submit details of the coating systems to be applied.

1.3 Quality Assurance

- .1 This Specification is intended to be a minimum reference standard.

2. PRODUCTS

2.1 Surface Preparation

- .1 Immersion Service: After degreasing, dry blast all ferrous components to a white metal finish in accordance with Steel Structures Painting Council (SSPC)-SP5 to a degree of cleanliness in accordance with National Association of Corrosion Engineers (NACE) No. 1 and obtain a 50 μ blast profile.
- .2 Non-immersion Service: After degreasing, dry blast all ferrous components to a near white finish in accordance with SSPC-SP10 to a degree of cleanliness in accordance with NACE No. 3 and obtain a 50 μ blast profile.

2.2 Coatings

- .1 All raw water steel pipes, valves, couplings, and fittings shall be epoxy coated internally and externally.
- .2 Prime coat all interior and exterior ferrous surfaces with epoxy coatings conforming to National Sanitation Foundation (NSF) Standard 61 – Drinking Water System Components, suitable for use in potable water applications, before the blasted surfaces deteriorate.
- .3 Coat ferrous surfaces with inorganic zinc primer, containing a minimum of 50% solids by volume, applied to a minimum dry film thickness of 75 μ .
- .4 Finish coat all interior and exterior ferrous surfaces with epoxy coatings conforming to NSF Standard 61 – Drinking Water System Components, suitable for use in potable water applications.
- .5 For submerged service, finish coatings on interior and exterior surfaces shall have a minimum total dry film thickness of 406 μ . For non-submerged service, interior and exterior finish coatings shall have a minimum total dry film thickness of 406 μ .

FACTORY APPLIED MAINTENANCE AND CORROSION PROTECTION COATINGS

- .6 Coating materials shall be a two-component epoxy liquid.
- .7 Interior coating shall be white, external coating colours to be determined by the Contract Administrator.
- .8 Exterior epoxy coatings shall be a two (2) coat system with the final coat colour to be determined by the Contract Administrator.
- .9 Equipment and fittings having factory applied finish:
 - .1 Provide sufficient primer and finish coatings for use by the Installation Contractor to touch-up equipment after installation.

2.3 Assembly

- .1 For items which are to be bolted together before shipment, clean surfaces and coat before the parts are assembled.
- .2 Continuous weld all welded connections, sealing the mating surface completely. On completion of the welding and fettling, treat all weld seams with phosphoric acid solution. Rinse and thoroughly dry before the prime is applied.
- .3 Where dissimilar metals are mated insulate the mating surfaces from one another to provide protection against corrosion. Insulate bolts, nuts, washers, and rivets in a similar manner.
- .4 Use 304 stainless steel or better for all nuts, bolts, washers and similar fittings for immersion service. For non-immersion service, use 304 stainless or zinc or cadmium plated nuts, bolts, washers, and similar fittings. Clean and coat the inner face of non-threaded bolt holes as required for other surfaces.

3. EXECUTION

3.1 Inspection

- .1 Notify the Contract Administrator two (2) weeks before commencing the protective coating to permit the inspection by the Contract Administrator of the surface preparation and protective coating application.

3.2 Protection

- .1 Protect all coated equipment adequately against damage, dust, moisture, and scratching during shipment, off-loading and storage On-Site. If, in the opinion of the Contract Administrator, the coating is damaged during shipment to the extent that touch up would not be satisfactory, return and re-coat the equipment at the Contractor's cost.
- .2 Make good any damage to coatings occurring at any time prior to the transfer of custody to the Installation Contractor.

FACTORY APPLIED MAINTENANCE AND CORROSION PROTECTION COATINGS

3.3 Application Conditions

- .1 Apply all factory applied coatings under controlled conditions, in a dust-free atmosphere at a temperature of between 10 and 20°C, and a relative humidity should not exceed 80%.

END OF SECTION

VARIABLE FREQUENCY DRIVES

1. GENERAL

1.1 Standards

- .1 All variable frequency drives (VFDs) supplied under this Contract shall meet or exceeds the following Specifications.
- .2 Provide a complete inventory of spare cooling fans, and fuses, for each VFD supplied.
- .3 The adjustable frequency controller shall be designed to operate standard squirrel cage induction motor with a 1.15 S.F. or definite purpose motors meeting National Electrical Manufacturer's Association (NEMA) MG1 Part 31.
- .4 Harmonic loading shall not exceed a motor service factor of 1.0.
- .5 Products shall comply with Institute of Electrical and Electronic Engineers (IEEE) Standard 519.
- .6 VFD unit shall be Underwriters Laboratories Inc. (UL) listed and Canadian Standard Association (CSA) certified.
- .7 VFD unit shall comply with applicable requirements of the latest standards of CSA, American National Standards Institute (ANSI), IEEE, and the Canadian Electrical Code (CEC).

1.2 Tests

- .1 Factory testing
 - .1 VFD units are to be factory tested prior to shipment. Provide confirmation from factory of actual tests completed and results.
 - .2 Provide certified copies of production test results required by CSA and Electrical and Electronic Manufacturer's Association of Canada (EEMAC) to the Contract Administrator, prior to acceptance of the equipment.
- .2 Field testing
 - .1 The VFD Manufacturer's Representative shall provide on-site start-up, fine-tuning, commissioning, operator training and instruction.
 - .2 The VFD Manufacturer's Representative shall provide Site functionality test reports indicating loading/current levels during testing as well as control point proving results.
 - .3 The VFD Manufacturer's Representative shall ensure shaft to ground voltages do not exceed 1.5 V at any speed or load requirement.

VARIABLE FREQUENCY DRIVES

- .4 Allow for all costs and labour for as many trips as necessary to complete requirements.
- .5 It is the intent of this Specification to provide a VFD installation that does not adversely affect the electrical system.

The VFD Manufacturer's Representative shall evaluate the predicted effect of the VFD installation on electrical system and advise the Contract Administrator of these effects. Further information about the electrical distribution on-site will be provided upon request.

- .3 Provide certified copies of all production test results required by CSA and NEMA.

2. PRODUCTS

2.1 Variable Frequency Drives

- .1 VFD as supplied by the following acceptable Manufacturer:
 - .1 ABB ACS 1000i series.
- .2 Application for the VFDs is for the Deacon Booster Pumps as described in **Section 11320 – Process Pumps Horizontal Centrifugal Pumps**.
- .3 Each VFD supplied under this Contract shall be of a modular design that allows for the complete withdrawal of the power module and all electronics from the outer cabinet. For the purpose of removing the power module, the power bars shall be disconnected at the module, some securing screws shall be removed and the power module can then be removed.
- .4 Variable speed controller shall be electronic adjustable frequency and voltage output unit.
- .5 The VFD shall employ a minimum 12 pulse width modulated (PWM) inverter system utilizing Insulated Gate Bipolar Transistors (IGBT) power switching devices and come complete with line reactors or DC link filters.
- .6 The drive shall be rated for continuous duty while operating a NEMA design induction motor of the sizes and operating voltages as shown in the following schedules and indicated on the Drawings. Drive output shall be sized for a 1.0 motor service factor. The VFD shall have a current rating at least 10% in excess of the motor full load amp rating. Overload service factors of 110% for thirty (30) minutes and 135% for one (1) minute must be provided to ensure adequate safety margins. VFD selection shall be based on load current at constant torque ratings. Do not size VFD's based on variable torque maximums.

VARIABLE FREQUENCY DRIVES

- .7 The VFD shall have a fixed bridge type converter (PWM) with a minimum of 98% input displacement power factor over a 10 to 100% speed range. The efficiency shall be a minimum of 97% for all inverters when operated at full speed and load.
- .8 Input voltage shall be as indicated on motor schedules and Drawings (line voltage variation $\pm 10\%$) based on 4160 V systems. Line frequency variation $\pm 5\%$. Output voltage shall vary with motor speed to nominal motor voltage. Speed stability shall be $\pm 1\%$. Drive shall match torque characteristic of load.
- .9 Input frequency setting signal will be 4 to 20 mA. Output speed monitoring signal shall be 4 to 20 mA.
- .10 Enclosure:
 - .1 Drive shall be installed in motor control centres or with individual CSA one (1) enclosure, drip proof or NEMA 12. Filters to be provided for any forced air cooled enclosures as required by the Manufacturer. VFD(s) shall be suitable for mounting in a typical building electrical room and shall be able to operate under these conditions with no special cleaning requirements. VFD cabinets shall be mounted in such a way that there is adequate room for ventilation and no build up of heat. The minimum clearance in front of VFD's is 1 m.
- .11 Protective devices to be incorporated are:
 - .1 Fast acting electronic circuit board protective devices for protection of electronic components for line transients and energy levels, response time – sub-nanoseconds as recommended by the VFD manufacturer.
 - .2 Line reactor, DC link or filter in the drive input to protect electronic components from transient voltage conditions.
 - .3 Design and supply with each VFD the required harmonic filter to comply with IEEE 519 – Standard – to control and mitigate harmonic distortion caused by the VFD. The harmonic filter shall be MTE Matrix Harmonic Trap Filter or approved equivalent.
 - .4 Integral electronic motor overload protection adjustable up to 150% of motor rating for sixty (60) seconds.
 - .5 Overcurrent instantaneous trip 250%.
 - .6 Programmable short-circuit protection.
 - .7 Programmable ground fault protection.
 - .8 Overvoltage/overcurrent DC bus monitor/protection.
 - .9 Undervoltage protection.

VARIABLE FREQUENCY DRIVES

- .10 Loss of phase and phase unbalance protection.
 - .11 Inverter over-temperature protection.
 - .12 Capable of running without motor for start-up.
 - .13 Design and supply with each VFD the required Inverter Output dv/dt filter to limit motor voltage to 10,000 V maximum at motor terminals. The output filter shall be TCI KLC filter or approved equal.
 - .14 Longlead (motor feeder) filter package, as required for these installations. Contractor is responsible to determine where this will be required, and must indicate as to the requirement or non-requirement of longlead filter package components in their submittals.
 - .15 Maximum acceptable noise level is 80 dBA at 1 m.
- .12 Operation features:
- .1 Integral flush mounted display in VFD cover with keypad for programming, monitoring and operating of drive, accessible through password or other acceptable security measure only.
 - .2 Fault shutdown and indication.
 - .3 Automatic restart following power outage.
 - .4 Ability to disconnect motor load for setup or trouble.
 - .5 Manual speed control (potentiometer or keypad).
 - .6 Adjustable maximum and minimum speed.
 - .7 Acceleration and deceleration time adjustment.
 - .8 Controller “stop” interlock from a NC dry contact.
 - .9 Drive fault contact.
 - .10 Stop/start push buttons on key pad.
 - .11 Transient voltage protection.
 - .12 Provide three (3) dry “C” type contacts programmable for any combination of the following:
 - .1 Running (output frequency being generated).
 - .2 Fault lockout.

VARIABLE FREQUENCY DRIVES

- .3 Stopped.
- .4 At speed.
- .5 Under speed.
- .6 Forward/Reverse.
- .7 Low reference.
- .8 Manual/Auto Mode.
- .9 Local/Remote Mode.

- .13 Soft start sequence.
- .14 Minimum of three (3) skip frequencies.
- .15 Provide Computer/Off/Hand selector switch. Keypad C/O/H is not an acceptable replacement.
- .16 Password protection of parameter programming or some method to prevent unauthorized changes.
- .17 Output speed monitoring signal to be 4 to 20 mA.
- .18 Ethernet data communication gateway.
 - .1 A data communication gateway shall be provided for the connection to the Ethernet Plant Control and Monitoring System. The data communication protocol shall be Modbus/ TCP.

- .13 Environmental Capabilities: The drive shall operate without mechanical or electrical damage under any combination of conditions as follows:
 - .1 Ambient temperature 0° to 40° C.
 - .2 Humidity 0 to 90% (non condensing).
 - .3 Vibration up to 0.5 g.
 - .4 Altitude 0 to 1250 m.

- .14 Diagnostic and indicating features:
 - .1 Power On indication.
 - .2 Percentage speed indicator.
 - .3 Overload indication.

VARIABLE FREQUENCY DRIVES

- .4 Short circuit indication.
- .5 Ground fault indication.
- .6 Overvoltage indication.
- .7 Undervoltage indication.
- .8 High temperature (controller).
- .9 AC voltmeter (output).
- .10 AC ammeter (output).
- .11 Inverter ready.
- .12 Inverter fault.
- .13 External fault.
- .15 Cooling System:
 - .1 Contractor to provide adequate proven cooling devices for VFD equipment.
 - .2 Contractor to ensure any enclosure utilized will not allow a build up of heat. This can be accomplished by use of fans and/or sufficient guarded, filtered openings.
- .16 Normal Distribution
 - .1 Normal power distribution is subject to voltage surges and sags as a normal condition of operation. Design and supply with each VFD the required inverter protection such that the VFD will not be stressed or damaged, in the following conditions:
 - .1 Line surges of up to 115% of rated voltage for up to ten (10) cycles based on 4160 V systems.
 - .2 Line voltage sags down to 85% of rated voltage of up to one (1) second duration.
 - .2 Control wiring shall be TEW 105° C rise.
 - .3 Terminal blocks in separate control enclosures for remote interface shall be Weidmueller SAK6N or approved equivalent.
 - .4 Provide wire markers at both ends of all control wires, Electrovert Type Z or approved equivalent.
- .17 Spare VFD

VARIABLE FREQUENCY DRIVES

- .1 Provide and supply one complete VFD as spare unit. The spare unit will be used to replace a failed unit. All components shall be supplied as all for VFDs supplied with the pumps. The spare VFD shall be configured with the same parameters as all other VFDs. Harmonic Input Filter and Inverter Output filter need not to be supplied with the spare VFD.

2.2 Soft Starter Bypass

- .1 Design and supply with each VFD (except for the spare VFD) a Soft Starter Bypass to provide a further degree of redundancy to the overall system in the event of a VFD malfunction. Each pump could be placed into service at full speed and the VFD is totally isolated for repair work or maintenance. The soft starter shall be manufactured by ABB or approved equal and shall be fully incorporated into the by-pass system complete with isolation contactor(s) and up-to-speed by-pass contactor.

3. EXECUTION

3.1 Operations Manual Information

- .1 The Contractor shall provide the VFD Manufacturer as built of each motor application. Motor application data will include at a minimum, the following:
 - .1 Motor Manufacturer.
 - .2 Class.
 - .3 Motor model number.
 - .4 Motor serial number.
 - .5 Motor frame.
 - .6 Motor horsepower.
 - .7 Motor full load amps.
 - .8 Motor conductor size.
 - .9 Ground conductor.
 - .10 Length of conductors from VFD to Motor.
 - .11 Motor master control panel (MCP) or fuse and overload.
- .2 Installation
 - .1 Identify mounting requirements including concrete pads for all floor mounted equipment.

VARIABLE FREQUENCY DRIVES

- .2 The Contractor shall make provisions for the wiring of all interlocks including (but not limited to) vibration switches to the VFD. These interlocks will be active in both the Hand (local) or Auto (remote) configurations.
 - .3 Contractor shall ensure that all safety interlocks, control and stop commands shut down the drive as per Manufactures recommended procedure (example, ramp to stop, ramp and hold, or coast to stop). Contactors on the line or load side of the drive are not an approved method of control.
 - .4 VFD and motor isolation switch shall be labelled with proper shutdown procedures as follows:
 - “Caution”**
 - “* Ensure VFD is stopped before operating this switch”
 - “* Record all faults before resetting”
 - .5 Motor supply cables/conductors shall be run in conduits separate from supply feeders to line side of VFD. No conductors (supply or motor feeders) are to be taped or otherwise bundled within the conduits.
- .3 Field Quality Control
- .1 Contractor shall be responsible for complete commissioning of each VFD to satisfaction of the Contract Administrator and the City. Contractor shall allow for factory representative to completely calibrate all drive circuits after installation On-Site.
 - .2 The Contractor shall be responsible for having the Manufacturer representative return to the Site to reset, repair, and re-commission the VFD during the warranty period if problems arise with the normal operation of the VFD. This includes prevention of any motor shaft voltages exceeding 1.5V when referenced to ground.
- .4 Software
- .1 Provide VFD programming/troubleshooting software to City.
 - .2 Provide VFD Parameter list “as programmed during commissioning” for each VFD.
- .5 VFD Shop Drawings.
- .1 The Contractor shall indicate the level of local support detailing response time if a piece of equipment should happen to fail or malfunction. Details are to include estimated replacement part delivery times, as well as nearest parts depot location and a contact name and phone number.
 - .2 The Shop Drawings for each type/size of VFD must be specific to that unit. A generic Shop Drawing is not acceptable. The Shop Drawings are to include

VARIABLE FREQUENCY DRIVES

dimensions and physical details of the cabinets, a wiring diagram and a ladder diagram showing both internal connections and terminals for field wiring.

- .3 Provide labels/lamacoids on each VFD, isolation switch as follows:

“Caution”

“* Ensure VFD is stopped before operating this switch”

“* Record all faults before re-setting”

- .4 All Drawings, manuals, parameter settings, and test reports are to be included with the “Electrical Maintenance Manual”. This manual shall be issued in both Hard Copy and Electronic format.

END OF SECTION

INSTRUMENTATION AND CONTROL GENERAL REQUIREMENTS

1. GENERAL

1.1 Requirements of Work

- .1 Supply, and provide warranty for a complete and fully documented instrumentation and control (I&C) system as shown on the Drawings and specified herein. The I&C system will form a subsystem of the overall plant control system and contains vendor 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.
- .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 Documentation provided by the Contractor shall be formatted as follows:
 - .1 Piping and Instrumentation Diagram (P&ID) – Depict the general intent of the control systems and are to be used as the governing document for the scope of Work.
 - .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 Instrument Specification Sheets – Detail the relevant data for the supply of devices.

INSTRUMENTATION AND CONTROL GENERAL REQUIREMENTS

- .4 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.
 - .5 Standard Details – Provide a reference for installation, operation, and other instructions pertinent to a particular device.
 - .6 Detailed Specification – Lists qualifications, quality of materials and workmanship, and supplementary information.
- .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.

| <u>Reference</u> | <u>Title</u> |
|--------------------------|--|
| API RP550-86 | Manual on Installation of Refinery Instruments and Control Systems, Part I – Process Instrumentation and Control Section one (1) Through thirteen (13) |
| ASTM D883-89 | Terms Relating to Plastics |
| IEEE 100-88 | Dictionary of Electrical and Electronic Terms |
| ISA RP7.1-56 | Pneumatic Control circuit Pressure Test |
| ISA 5.4-76 | Instrument Loop Diagrams |
| ISA S51.1-79 | Process Instrumentation Terminology |
| NEMA 250-85 | Enclosures for Industrial Controls and Systems |
| NEMA ICS 1-88 | General Standards for Industrial Controls and Systems |
| NEMA ICS 2-88 | Industrial Control Devices, Controllers, and Assemblies |
| NFPA 70-90 | National Electrical Code (NEC) |
| SAMA PMC 17-10-63 | Bushings and Wells for Temperature Sensing Elements |
| UBC-88 | Uniform Building Code |
| UL 94-80 | Tests for Flammability of Plastic Materials for Parts in Devices and Appliances |
| Weik, Martin H. | Communications Standard Dictionary, Van Nostrand Reinhold Co., 1983 |

INSTRUMENTATION AND CONTROL GENERAL REQUIREMENTS

- .7 Related Work
 - .1 Process: Division 11
- .8 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.
- .9 Standards of Workmanship
 - .1 Execute all Work in a manner which will result in the completed installation presenting an acceptable appearance, to a level of quality specified in the general conditions of this Specification.
 - .2 Install Products in accordance with the recommendations and ratings of the Product Manufacturers.
- .10 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 If discrepancies or omissions in the Drawings or Specifications are found, or if intent or meaning is not clear, consult the Contract Administrator for clarification before submitting Tender.
 - .6 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.

INSTRUMENTATION AND CONTROL GENERAL REQUIREMENTS

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 here.
 - .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 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.
- .2 Take all necessary precautions to ensure that equipment is supplied free of damage. If deemed necessary by the Contract Administrator, damaged equipment shall be replaced with new Product. The Contractor shall bear any costs due to construction delays resulting from the delay in delivery of acceptable equipment.

1.3 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 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.
 - .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.

INSTRUMENTATION AND CONTROL GENERAL REQUIREMENTS

- .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 Manufacture of Products shall conform to Shop Drawings marked as reviewed by the Contract Administrator and returned to the Contractor.
- .5 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.

2. PRODUCTS

2.1 General

- .1 Refer to the requirements of **Division 1**.

INSTRUMENTATION AND CONTROL GENERAL REQUIREMENTS

- .2 Selected Products.
 - .1 Provide Products and materials that are new and free from all defects.
- .3 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 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.
- .4 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.
- .5 Product Finishes
 - .1 Contractor to specify 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.
- .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.

INSTRUMENTATION AND CONTROL GENERAL REQUIREMENTS

- .4 Clearly mark all panels, pull boxes, junction boxes, etc. to indicate the nature of service.
- .5 For direct current wiring use black for positive and white for negative.
- .6 For thermistor wiring to motors use red and blue coloured insulated wire.

3. EXECUTION

3.1 Coordination With Other Divisions

- .1 Examine the Drawing 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.

| Segregation between circuits | Very Noisy | Noisy | Indifferent | Sensitive | Very Sensitive |
|-------------------------------------|------------------------------|------------------------------|------------------------------|------------------|-----------------------|
| Very Noisy | Thermal grouping as per CEC. | 150 mm | 300 mm | 300 mm | 300 mm |
| Noisy | 150 mm | Thermal grouping as per CEC. | 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 |

INSTRUMENTATION AND CONTROL GENERAL REQUIREMENTS

3.4 Wire and Cable

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

3.5 Tagging Standards for Devices and Wiring

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

3.6 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 half of 1% of full range, or to the Manufacturer’s state accuracy of the instrument whenever an accuracy of half of 1% is not achievable.
- .5 Prior to shipping the instrument, perform the following applicable calibration for each instrument and its associated signal conditioning equipment:
 - .1 Calibrate all vacuum and pressure instruments by manometer or accurate test instrument and hand test pump.
 - .2 Calibrate temperature instruments against a standard lab thermometer.

3.7 Test Forms

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

INSTRUMENTATION AND CONTROL GENERAL REQUIREMENTS

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. _____ | | | | | | | | |
| SHEET NO. _____ | | | | | | | | |
| P & I DWG. NO. _____ | | | | | | | | |
| INSTALLATION COMPLETE | | | | | | | | |
| Primary Element. | | | | | | | | |
| Impulse Lines. | | | | | | | | |
| Block and Drain Valves. | | | | | | | | |
| Air Supply/Filter/Reg. | | | | | | | | |
| Wiring. | | | | | | | | |
| Tracing/Insulation/Housing. | | | | | | | | |
| Mounting and Location. | | | | | | | | |
| PLC/SCADA I/O & Status. | | | | | | | | |
| CALIBRATED | | | | | | | | |
| Impulse Lines Press. Tested. | | | | | | | | |
| LOOP CHECKED | | | | | | | | |
| 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

3.8 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 the Installation Contractor to commission the interface to the Plant Supervisory Control And Data Acquisition (SCADA) System.

3.9 Training

- .1 Provide training, described in detail in **Division 1**, as required by the plant's personnel to become fully competent in the proper O&M of all control devices, control valves, and ancillary instrumentation described under this Section of the Specification.

END OF SECTION

1. GENERAL

1.1 References - General

- .1 Suppliers, 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.
- .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 1A gasketed enclosures for installation 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 (i.e. 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 eleven (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.

- .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 panel fabricator.

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.
- .2 Tag each wire at both ends with a heat shrink sleeve that is machine printed.
- .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 wireways such as Panduit. Size all wireways so that the total cross sectional area of the insulated wire and cable does not exceed 40% of the cross sectional area of the wireway.
- .5 Provide a minimum clearance of 40 mm between wireways 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:
 - .1 Wire identification to use the connected field device tag name with the wire's corresponding terminal number appended to it.
 - .2 Identify every joint and/or terminal of the above wire run with the same identifier until the wire meets another tagged device, at which point the wire identifier will change to use the new device name and terminal number.
 - .3 Identify spare wires by using the destination identifier, i.e. the location and terminal identifier of the opposite end of the wire are combined to form the wire tag.

- .7 Provide a 120 VAC panel power distribution system 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 Wieland WK4TSK/U type 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 Wieland Type WK4/U color coded as follows:

| | | |
|-------|---|--------------------------------------|
| Red | = | positive 24 VDC |
| Black | = | 0Vdc common and analog signal plus |
| White | = | analog signal common and VAC neutral |
| Grey | = | 120 VAC |
| Green | = | ground |
- .11 Provide nameplates for each device on or within the panels and enclosures. Nameplates shall be black lamicooid with white lettering, a minimum of 25 x 75 mm in size with up to three lines of 3 mm lettering. Securely fasten nameplates in and situate them in a visible location.

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 backpanels 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 Controls General Requirements.**

END OF SECTION

INSTRUMENTATION CABLE

1. GENERAL

1.1. Product Data

- .1 Submit product data in accordance with **Division 1**.
- .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 panels that are not located within the same skid will be supplied and installed by others.

1.2. Related Work

- .1 Refer to **Division 11**.

1.3. Standards

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

2. PRODUCTS

2.1. Twisted Pair Shielded Cables

- .1 Twisted Pair Shielded Cables (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 equivalent.
- .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

2.2. Resistance Temperature Detector and Multi Conductor Shielded Cable

- .1 Resistance Temperature Detector (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 CSA-C22.2

3. EXECUTION

3.1. Analog Signals

- .1 Use RTD cable for connections between RTDs and transmitters or programmable logic controller (PLC) RTD inputs.

3.2. 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.

3.3. Installation

- .1 Installation shall be by others.

3.4. 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.

3.5. Testing

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

INSTRUMENTATION CABLE

3.6. 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

PROCESS TAPS AND PRIMARY ELEMENTS

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 Process Taps

- .1 Provide pressure gauge and thermowell taps in accordance with **Division 11.**

2.2 Primary Elements

- .1 Provide written assurance that the instrument Manufacturer approves the selection for the primary element materials that are in contact with the specified process fluid and certifies that the materials are inert to the effects of the process fluid.
- .2 Provide diaphragm seals for any fluid other than clean water or glycol.
- .3 When diaphragm seals are specified with a pressure gauge or a pressure switch provide the assembly filled with ethylene glycol and calibrated by the Manufacturer.
- .4 Provide ethylene glycol filled assembly calibrated by the Manufacturer when in-line pressure sensors are specified with a pressure gauge or a pressure switch or in combination.

3. EXECUTION – NOT USED

END OF SECTION

TRANSMITTERS AND INDICATORS

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 Transmitters and Indicators

- .1 Provide transmitters and indicators as specified here and in **Section 17010 – Instrumentation and Control General Requirements.**
- .2 Transmitters shall have adequate power output to drive all devices associated with the signal loop. All analogue signals from transmitters shall be in the form of 4 to 20 mA DC. Provide signal boosters as required to achieve adequate signal strength or to isolate the signal.
- .3 Provide a lamicoid label indicating the calibrated range and engineering units and mount adjacent to the transmitter.
- .4 Where available as an option, the transmitter shall be supplied with an isolated fault contact.
- .5 Standard of acceptance for instrumentation shall be as follows:
 - .1 Temperature Transmitters (RTD): Rosemount, ABB, Foxboro.
 - .2 Speed Sensor complete with signal converter/transmitter: Electro Sensors Incorporated, Bentley Nevada.
 - .3 Vibration Sensor Transmitters: Robertshaw Industrial Controls, Entek/IRD, PMC Beta, Bentley Nevada.

3. EXECUTION

3.1 References - General

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

END OF SECTION

POWERED ACTUATORS

1. GENERAL

1.1 Work Included

- .1 Supply, verification of the On-Site equipment installation, testing and commissioning of electric powered actuators and accessories for variable speed drive (VSD) pump couplings.
- .2 Size and match powered actuators to VSD pump coupling as specified in **Section 11330 – Variable Speed Drives**.

1.2 Submittals for Review

- .1 Provide Submittals in accordance with **Division 1** and **Section 17010 – Instrumentation and Control General Requirements**.
- .2 Furnish Shop Drawings for complete actuator assemblies and accessories prior to delivery.
- .3 Provide calculations for sizing, noise, and actuator torque calculations, etc., in addition to the requirements of **Division 11**.
- .4 Submit a completed Instrumentation, Systems and Automation Society (ISA) S20.50 Instrument Specification Sheet for each device.

1.3 Submittals for Information Only

- .1 Submit the following in addition to the requirements of **Division 1** and **Section 17010 – Instrumentation and Control General Requirements**:
 - .1 Factory calibration and testing reports: Handwritten reports will not be accepted.
 - .2 Operations and maintenance (O&M) manuals in accordance with **Division 11**.

1.4 Service Conditions

- .1 Provide electrical enclosures rated for wet and corrosive areas.
- .2 Refer to **Section 17010 – Instrumentation and Control General Requirements** for additional details.

1.5 Shipment

- .1 Ship equipment in accordance with **Division 1** and **Section 17010 – Instrumentation and Control General Requirements**.

1.6 Delivery

- .1 Deliver actuators to Site use loading methods which do not damage casings or coatings.

POWERED ACTUATORS

- .2 Clearly tag all control valves and actuators, stating size, type, coatings and mating parts.

1.7 Process Valve and Actuator Schedules

- .1 Refer to the Instrument Specification Sheets and the instrument index for valve and actuator identification and for details. Power actuated devices which require automation, as shown on the Piping and Instrumentation Diagrams (P&IDs) have their actuators and all ancillary instrumentation specified under **Division 17**. The device material Specifications are found under **Division 11**.
- .2 Actuator abbreviations are referenced in the Instrument Specification Sheets and described in part 2.2 of this Section.

2. PRODUCTS

2.1 General

- .1 Provide new material only.
- .2 Provide all actuator mounting hardware and accessories mounted on the device prior to shipment.
- .3 Provide actuators of National Electrical Manufacturer's Association (NEMA) 4 construction, suitable for use in an industrial environment.
- .4 Provide device and actuator as a matched set from the same Manufacturer wherever possible.
- .5 Where available, actuators shall be provided with Modbus/TCP communications capability.
- .6 Tag the control devices, accessories and actuators to indicate operating characteristics. Electric actuators must be Canadian Standards Association (CSA) approved.

2.2 Actuator Types

- .1 Electric Linear Actuators, Modulating Type (EMLM)
 - .1 Unless noted otherwise, the actuator will fail to the last position when the control function or power fails.
 - .2 Unless otherwise specified, electric actuators to be 120 VAC, 1 phase, 60 Hz for service where required torque is less than 115 N-m and 600 VAC, 3 phase, 60 Hz for service with torque above 115 N-m. Provide each actuator with a high torque, reversible motor which is capable of continuous duty over the full operating range.
 - .3 Approved electric actuator Manufacturers are Limatorque, Rotork, and Honeywell.

POWERED ACTUATORS

- .4 Electric actuators for VSD couplings to be comprised of an electric motor, gear train, crank arm and output shaft.
- .5 Provide a sufficiently sized motor to move the VSD magnetic plates across the full range of the gap opening in small increments in response to control signals.
- .6 The actuator speed shall be adjustable.
- .7 The actuator shall be fully compatible with the VSD coupling mechanical arrangement. Mount at operating height on the pump frame.
- .8 Protect motors against overload and reverse phase rotation.
- .9 The drive train to be rated for heavy duty, continuous service.
- .10 House the internal components of actuators and related gear boxes in weather proof, corrosion proof metal enclosures. All electrical and mechanical components shall be capable of continuous operation in an ambient temperature range of -40°C to +40°C.
- .11 Fit actuators with a capstan hand wheel operator. Fit hand wheel assemblies with a clutching mechanism which prevents hand wheel operation during normal motor operation.
- .12 Fit removable safety guards over all moving drive train components between the actuator and each gear box.
- .13 Provide SPDT end of travel limit switches on each actuator. In addition each actuator shall have at least two (2) programmable SPDT relays for remote signaling of faults etc.
- .14 Each actuator shall have electronic positioner to control the coupling position in response to a continuous 4 to 20 mA DC input signal.
- .15 Each actuator shall have a position feedback output in the form of a continuous 4 to 20 mA DC signal.
- .16 Provide a local Computer-Off-Hand switch to allow local manual operation of the actuator.

3. EXECUTION

3.1 Field Testing and Commissioning

- .1 Provide testing and commissioning in accordance with **Division 1** and **Section 17010 – Instrumentation and Control General Requirements**, Part 3.
- .2 Factory test each actuator assembly prior to shipment.

POWERED ACTUATORS

3.2 Training

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

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

- .2 120 VAC relays to be Model LY 4PDT, plug-in, complete with test button, operation indicator, and surge suppressor.
- .3 24 VDC relays to be Model MY 2PDT 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, 2PDT, 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

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 The operator interface to the plant control system will be supplied, installed, programmed, and commissioned under a separate contract. 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 The Contractor will support the design, installation, programming, and start-up of the plant control system as follows:
 - .1 Supply all field instrumentation necessary to facilitate monitoring and control of the system.
 - .2 Provide all necessary local controls to allow local operation such that it compliments the operation of the plant control system to facilitate 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 specified in **Division 11**.
 - .3 Provide all hardware interfaces required to facilitate the interconnection of the contractor supplied programmable logic controller (PLC) control system to the plant control system.
 - .4 Provide all written descriptions and associated Drawings necessary to fully describe the detailed operation of the entire system supply and to allow the development of application software on the operator interface network by others. 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, either as print-out or in electronic bitmap format.
- .3 For the purpose of this project, the tag name convention used on the Input/Output (I/O) lists included with the specifications and shown on the Piping and Instrumentation Diagrams (P&IDs) and will be used. Coordinate the implementation of tags for any instrumentation not listed with the Contract Administrator.

2. PRODUCTS - NOT USED

OPERATOR INTERFACE REQUIREMENTS

3. EXECUTION

3.1 Performance – General

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

3.2 Installation

- .1 Provide hardware in accordance with the foregoing requirements in sufficient quantity to satisfy the performance requirements specified in this and other Divisions of this Specification.
- .2 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.
- .3 Assist with commissioning and system start-up as specified in **Section 01650 – Equipment Installation**.
- .4 Provide all documentation and training as specified in **Section 01650 – Equipment Installation**.

END OF SECTION