THE CITY OF WINNIPEG

BID OPPORTUNITY

BID OPPORTUNITY NO. 429-2005

WINNIPEG WATER TREATMENT PROGRAM – SUPPLY OF POLYMER FEED EQUIPMENT

TABLE OF CONTENTS

PART B - BIDDING PROCEDURES

B1. PROJECT TITLE

B1.1 WINNIPEG WATER TREATMENT PROGRAM – SUPPLY OF POLYMER FEED EQUIPMENT

B2. SUBMISSION DEADLINE

B2.1 The Submission Deadline is 4:00 p.m. Winnipeg time, September 7, 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. ENQUIRIES

B3.1 All enquiries shall be directed to the Contract Administrator identified in D4.1.

B3.2 If the Bidder finds errors, discrepancies or omissions in the Bid Opportunity, or is unsure of the meaning or intent of any provision therein, the Bidder shall notify the Contract Administrator of the error, discrepancy or omission, or request a clarification as to the meaning or intent of the provision at least five (5) Business Days prior to the Submission Deadline.

B3.3 Responses to enquiries which, in the sole judgment of the Contract Administrator, require a correction to or a clarification of the Bid Opportunity will be provided by the Contract Administrator to all Bidders by issuing an addendum.

B3.4 Responses to enquiries which, in the sole judgment of the Contract Administrator, do not require a correction to or a clarification of the Bid Opportunity will be provided by the Contract Administrator only to the Bidder who made the enquiry.

B3.5 The Bidder shall not be entitled to rely on any response or interpretation received pursuant to B3 unless that response or interpretation is provided by the Contract Administrator in writing.

B4. ADDENDA

B4.1 The Contract Administrator may, at any time prior to the Submission deadline, issue addenda correcting errors, discrepancies or omissions in the Bid Opportunity, or clarifying the meaning or intent of any provision therein.

B4.2 The Contract Administrator will issue each addendum at least two (2) Business Days prior to the Submission Deadline, or provide at least two (2) Business Days by extending the Submission Deadline.

B4.2.1 Addenda will be available on the Bid Opportunities page at The City of Winnipeg, Corporate Finance, Materials Management Branch internet site at http://www.winnipeg.ca/matmgt.

B4.2.2 The Bidder is responsible for ensuring that he has received all addenda and is advised to check the Materials Management Branch internet site for addenda shortly before submitting his Bid.

B4.3 The Bidder shall acknowledge receipt of each addendum in Paragraph 9 of Form A: Bid. Failure to acknowledge receipt of an addendum may render a Bid non-responsive.

B5. SUBSTITUTES

B5.1 The Work is based on the materials, equipment, methods and products specified in the Bid Opportunity.

B5.2 Substitutions shall not be allowed unless application has been made to and prior approval has been granted by the Contract Administrator in writing.

B5.3 Requests for approval of a substitute will not be considered unless received in writing by the Contract Administrator at least seven (7) Business Days prior to the Submission Deadline.

B5.4 The Bidder shall ensure that any and all requests for approval of a substitute:

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

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

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

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

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

B5.5 The Contract Administrator, after assessing the request for approval of a substitute, may in his sole discretion grant approval for the use of a substitute as an “approved equal” or as an “approved alternative”, or may refuse to grant approval of the substitute.

B5.6 The Contract Administrator will provide a response in writing, at least two (2) Business Days prior to the Submission Deadline, only to the Bidder who requested approval of the substitute.

B5.6.1 The Bidder requesting and obtaining the approval of a substitute shall be entirely responsible for disseminating information regarding the approval to any person or persons he wishes to inform.

B5.7 If the Contract Administrator approves a substitute as an “approved equal”, any Bidder may use the approved equal in place of the specified item.

B5.8 If the Contract Administrator approves a substitute as an “approved alternative”, any Bidder bidding that approved alternative shall base his Total Bid Price upon the specified item but may also indicate an alternative price based upon the approved alternative. Such alternatives will be evaluated in accordance with B14.

B5.9 No later claim by the Contractor for an addition to the price(s) because of any other changes in the Work necessitated by the use of an approved equal or an approved alternative will be considered.

B6. BID SUBMISSION

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

(a) Form A: Bid;

(b) Form B: Prices;

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

B6.2 All components of the Bid Submission shall be fully completed or provided, and submitted by the Bidder no later than the Submission Deadline, with all required entries made clearly and completely in ink, to constitute a responsive Bid.

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

B6.3.1 Samples or other components of the Bid Submission which cannot reasonably be enclosed in the envelope may be packaged separately, but shall be clearly marked with the Bid Opportunity number, the Bidder's name and address, and an indication that the contents are part of the Bidder’s Bid Submission.

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

B6.5 Bid Submissions shall be submitted to:

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

B7. BID

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

B7.2 Paragraph 2 of Form A: Bid shall be completed in accordance with the following requirements:

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

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

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

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

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

B7.3 In Paragraph 3 of Form A: Bid, the Bidder shall identify a contact person who is authorized to represent the Bidder for purposes of the Bid.

B7.4 Paragraph 11 of Form A: Bid shall be signed in accordance with the following requirements:

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

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

(c) if the Bidder is a corporation, it shall be signed by its duly authorized officer or officers and the corporate seal, if the corporation has one, should be affixed;

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

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

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

B7.5 If a Bid is submitted jointly by two or more persons, the word "Bidder" shall mean each and all such persons, and the undertakings, covenants and obligations of such joint Bidders in the Bid Submission and the Contract, when awarded, shall be both joint and several.

B8. PRICES

B8.1 The Bidder shall state a price in Canadian funds for each item of the Work identified on Form B: Prices.

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

(a) duty;

(b) freight and cartage;

(c) Provincial and Federal taxes [except the Goods and Services Tax (GST) and Manitoba Retail Sales Tax (MRST, also known as PST), which shall be extra where applicable] and all charges governmental or otherwise paid;

(d) profit and all compensation which shall be due to the Contractor for the Work and all risks and contingencies connected therewith.

B8.2 Payment of the lump sum price will be made to the Contractor in accordance with the payment schedule set out in D20.

B9. QUALIFICATION

B9.1 The Bidder shall:

(a) undertake to be in good standing under The Corporations Act (Manitoba), or properly registered under The Business Names Registration Act (Manitoba), or otherwise properly registered, licensed or permitted by law to carry on business in Manitoba, or if the Bidder does not carry on business in Manitoba, in the jurisdiction where the Bidder does carry on business;

(b) be responsible and not be suspended, debarred or in default of any obligation to the City;

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

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

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

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

B9.2 The Bidder shall provide, on the request of the Contract Administrator, full access to any of the Bidder's equipment and facilities to confirm, to the Contract Administrator's satisfaction, that the Bidder's equipment and facilities are adequate to perform the Work.

B10. BID SECURITY

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

(a) a bid bond, in the amount of at least ten percent (10%) of the Total Bid Price, and agreement to bond of a company registered to conduct the business of a surety in Manitoba, in the form included in the Bid Submission (Form G1: Bid Bond and Agreement to Bond); or

(b) an irrevocable standby letter of credit, in the amount of at least ten percent (10%) of the Total Bid Price, and undertaking issued by a bank or other financial institution registered to conduct business in Manitoba and drawn on a branch located in Winnipeg, in the form included in the Bid Submission (Form G2: Irrevocable Standby Letter of Credit and Undertaking); or

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

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

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

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

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

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

B11. OPENING OF BIDS AND RELEASE OF INFORMATION

B11.1 Bid Submissions will not be opened publicly.

B11.2 Within two (2) Business Days following the Submission Deadline, the names of the Bidders and their Total Bid Prices (unevaluated, and pending review and verification of conformance with requirements) will be available on the Closed Bid Opportunities (or Public/Posted Opening & Award Results) page at The City of Winnipeg, Corporate Finance, Materials Management Branch internet site at http://www.winnipeg.ca/matmgt.

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

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

B12. IRREVOCABLE BID

B12.1 The Bid(s) submitted by the Bidder shall be irrevocable for the time period specified in Paragraph 10 of Form A: Bid.

B12.2 The acceptance by the City of any Bid shall not release the Bids of the next two lowest evaluated responsive Bidders and these Bidders shall be bound by their Bids on such Work for the time period specified in Paragraph 10 of Form A: Bid.

B13. WITHDRAWAL OF BIDS

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

B13.1.1 Notwithstanding GC.7.05(2), the time and date of receipt of any notice withdrawing a Bid shall be the time and date of receipt as determined by the Manager of Materials.

B13.1.2 The City will assume that any one of the contact persons named in Paragraph 3 of Form A: Bid or the Bidder's authorized representatives named in Paragraph 11 of Form A: Bid, and only such person, has authority to give notice of withdrawal.

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

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

(b) open the Bid Submission to identify the contact person named in Paragraph 3 of Form A: Bid and the Bidder's authorized representatives named in Paragraph 11 of Form A: Bid; and

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

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

B14. EVALUATION OF BIDS

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

(a) compliance by the Bidder with the requirements of the Bid Opportunity (pass/fail);

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

(c) Total Bid Price;

(d) economic analysis of any approved alternative pursuant to B5.

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

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

B14.4 Further to B14.1(c), the Total Bid Price shall be the lump sum price shown on Form B: Prices.

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

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

B15. AWARD OF CONTRACT

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

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

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

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

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

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

(d) only one Bid is received; or

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

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

PART C - GENERAL CONDITIONS

C1. GENERAL CONDITIONS

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

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

PART D - SUPPLEMENTAL CONDITIONS

GENERAL

D1. GENERAL CONDITIONS

D1.1 In addition to the *General Conditions for the Supply and Delivery of Goods*, these Supplemental Conditions are applicable to the Work of the Contract.

D1.2 The General Conditions are amended by striking out “The City of Winnipeg Act” wherever it appears in the General Conditions and substituting “The City of Winnipeg Charter”.

D1.3 The General Conditions are amended by striking out “Board of Commissioners” or “Commissioner” wherever it appears in the General Conditions and substituting the “Chief Administrative Officer”.

D1.4 The General Conditions are amended by striking out “Tender Package” wherever it appears in the General Conditions and substituting “Bid Opportunity”.

D1.5 The General Conditions are amended by striking out “Tender Submission” wherever it appears in the General Conditions and substituting “Bid Submission”.

D1.6 The General Conditions are amended by striking out “Bidding Instructions” wherever it appears in the General Conditions and substituting “Bidding Procedures”.

D2. SCOPE OF WORK

D2.1 The Work to be done under the Contract shall consist of the supply of polymer feed equipment..

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

(a) To supply a complete polymer feed equipment system including (but not limited to) delivery to Site, training, performance verification support, operation and maintenance manuals, equipment, accessories and spare parts.

(b) Electrical scope as defined in Section 16015.

(c) Control and instrumentation scope as defined in Section 17010.

D2.3 The Site is located on Provincial Road 207, 3 km north of Highway 1 in Dugald, Manitoba.

D2.3.1 The Site address is PR207, Lot 57082, Dugald, Manitoba.

D2.3.2 Provincial Road 207 is a class B1 road and is subject to seasonal load restrictions which will affect the maximum weight of individual deliveries. 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.

D3. DEFINITIONS

D3.1 When used in this Bid Opportunity:

(a) “**Business Day**" means any Calendar Day, other than a Saturday, Sunday, or a Statutory or Civic Holiday;

(b) “**Submission Deadline**” and “**Time and Date Set for the Final Receipt of Bids**” mean the time and date set out in the Bidding Procedures for final receipt of Bids;

(c) **Installation Contractor and/or Installer** means the General Contractor retained by the City, under a separate contract, to install the equipment supplied under this contract;

(d) **Substantial Performance** shall have the meaning attributed to it in the Builders' Lien Act (Manitoba), or any successor legislation thereto.

(e) **ANSI** means American National Standards Institute

(f) **ASME** means American Society of Mechanical Engineers

(g) **ASTM** means American Society for Testing and Materials

(h) **AWWA** means American Water Works Association

(i) **CSA** means Canadian Standards Association

(j) **DAF** means Dissolved Air Flotation

(k) **IEC** means International Electrotechnical Commission

(l) **ISO** means International Organization for Standardization

(m) **NACE** means National Association of Corrosion Engineers

(n) **NEMA** means National Electrical Manufacturers Association

(o) **NSF** means National Sanitation Foundation

(p) **SAE** means Society of Automotive Engineers

(q) **Manufacturer** means the person, partnership or corporation responsible for the manufacture and fabrication of equipment provided to the City for the completion of the work.

(r) **Manufacturer's Representative** means a trained serviceman empowered by the manufacturer to provide installation, testing, and commissioning assistance to the City in his performance of those functions.

(s) **IEEE** means Institute of Electrical and Electronics Engineers

(t) **NEMA** means National Electrical Manufacturer's Association

(u) **Furnish** means supply

(v) **ISA** means the Instrumentation Systems and Automation Society

(w) **Total Performance** means that the entire Work, except those items arising from the Provision of GC.10.01 have been performed in accordance with this Contract

(x) **AGMA** means American Gear Manufacturer's Association.

(y) **API** means American Petroleum Institute

(z) **EEMAC** means Electrical and Electronic Manufacturer of Canada

(aa) **VFD** means Variable Frequency Drive

(bb) **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

(cc) **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

(dd) **Professional Engineer** means a professional engineer registered in the Province of Manitoba.

(ee) **Major Equipment** means all equipment for which shop drawing submittals are required as specified in Division 11, 16 and 17.

(ff) **Process Unit** means the Manufacturer's complete equipment package including individual process components, skid mounted equipment and any related appurtenances.

(gg) **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

(hh) **Control System Integrator** means a contractor retained by the City (under a different contract) to program and configure the water treatment plant SCADA system.

(ii) **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 The technical terms related to pump operation shall be as defined in Section 11300 and the nomenclature of the Hydraulics Institute Standards.

D3.5 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) 986-8392
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 B10.1(c), the Contractor shall provide the City Solicitor with the required performance security within seven (7) Calendar Days of notification of the award of the Contract by way of letter of intent and prior to the commencement of any Work on the Site but in no event later than the date specified in GC.3.01 for the return of the executed Contract.

D11. SUBCONTRACTOR LIST

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

D12. WORK SCHEDULE

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

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

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

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

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

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

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

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

D12.9 The Contract Administrator shall be notified immediately when the work under the Contract Work Schedule will adversely affect the work of other Contractors and the critical path of the

Project Master Schedule as the work under the Contractor's Contract Work Schedule is an integral part of the Project Master Schedule.

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

D13. SECURITY CLEARANCE

D13.1 Each individual proposed to perform Work on the Site shall be required to obtain a Criminal Record Check Search Certificate from the Police Service having jurisdiction at his place of residence.

D13.2 Prior to the commencement of any Work, and during the term of the Contract if additional or replacement individuals are proposed to perform Work, the Contractor shall supply the Contract Administrator with a Criminal Record Search Certificate obtained not earlier than one (1) year prior to the Submission Deadline, or a certified true copy thereof, for each individual proposed to perform Work within City facilities or on private property.

D13.3 Any individual for whom a Criminal Record Search Certificate is not provided, or for whom a Criminal Record Search Certificate indicates any convictions or pending charges related to property offences or crimes against another person, will not be permitted to perform any Work within City facilities or on private property.

D13.4 Any Criminal Record Search Certificate obtained thereby will be deemed valid for the duration of the Contract subject to a repeated records search as hereinafter specified.

D13.5 Notwithstanding the foregoing, at any time during the term of the Contract, the City may, at its sole discretion and acting reasonably, require an updated criminal records search. Any individual who fails to provide a satisfactory Criminal Record Search Certificate as a result of a repeated criminal records search will not be permitted to continue to perform Work under the Contract within City facilities or on private property.

D14. PROCESS UNITS AND 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:

(a) Provide the Contract Administrator with a list of products to be provided under Division 17.

(b) Identify and submit to the Contract Administrator the power requirements, over current protection devices (fuses and/or breakers) and feeder size for each Process Unit to be supplied under this Contract.

(c) Provide a breakdown of the Total Bid Price to show itemized pricing for the supply of the DAF polymer preparation and feed system, filter aid polymer feed system, sludge polymer feed system and stand-by polymer preparation system.

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 work schedule specified in D12; and

(vii) the security clearances specified in D13.

(b) 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 Calgary, Alberta approximately 10 Business 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: Acceptable Shop Drawings for all Major Equipment shall be completed by October 14, 2005. Acceptable 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 January 1, 2007 and be completed no later than February 28, 2007,

(ii) The detailed delivery schedule will be based on the Installation Contractor's and the City's requirements and will be coordinated by the Contract Administrator, and included in the Contract Work Schedule. The Goods shall be supplied into the care of the Installation Contractor in accordance with this schedule,

(iii) Equipment delivery shall be considered complete upon the issuance of Form 100: Certificate of Equipment Delivery and Form 101: Certificate of Readiness to Install. A separate form shall be provided for each major component. These forms 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 equipment by July 3, 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 good 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 the entire system.

(d) Satisfactory Performance and Training: Performance Verification and Training shall begin no earlier than July 3, 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 sixty (60) 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 City will endeavour to award the Contract within fourteen (14) Calendar Days of the Submission Deadline. If award 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 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.

D16.4 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 December 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 Performance 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.

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 for performance 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 Lump Sum Price as listed in Form B: Prices, shall include all Shop Drawings, equipment, accessories, spare parts, delivery, performance verification and training.

(i) Two (2) percent of the Lump Sum Price will be paid upon the issuance of Certified Shop Drawings for the entire scope of this supply Contract.

(ii) Seventy-three (73) percent of the Lump Sum Price will be paid upon issuance of Forms 100: Certificate of Equipment Delivery and 101: Certificate of Readiness to Install and for transference of title to the City of Winnipeg for all major equipment.

(iii) A further ten (10) percent of the Lump Sum Price will be paid upon issuance of Form 102: Certificate of Satisfactory Installation.

(iv) A further ten (10) percent of the Lump Sum Price will be paid upon the issuance of Form 103: Certificate of Satisfactory Performance and

(v) A further five (5) percent of the Lump Sum Price will be paid upon the issuance of Form T1: Certificate of Satisfactory Training.

(b) Further to GC.9.03:

(i) Any payment made by the City to the Contractor on account of a progress estimate shall be less any holdback required to be made by The Builders' Liens Act, and such holdbacks or other amounts which the City is entitled to withhold pursuant to the Contract;

(ii) Payment on account of the final progress estimate, including the holdback made by the City pursuant to The Builders' Liens Act, shall be paid to the Contractor when the time for filing liens or trust claims has elapsed, unless the City is in receipt of a lien or trust claim.

WARRANTY

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 The Warranty period for all goods specified in Section 16815 shall be two years from Total Performance.

D21.4 Prior to Substantial Performance, 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.

D21.5 The Contractor shall responsible to bring the VFD Manufacturer’s Representative back to the Site to repair 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 1.5 volts when referenced to ground.

D21.6 New components which replace defective components under warranty shall have a warranty period identical to the warranty period that replaced component had at substantial performance. The warranty period for the new components shall begin on the date that they are performance tested and accepted by the City.

CONTROL OF WORK

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

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. 429-2005

WINNIPEG WATER TREATMENT PROGRAM – SUPPLY OF POLYMER FEED EQUIPMENT

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. 429-2005

WINNIPEG WATER TREATMENT PROGRAM – SUPPLY OF POLYMER FEED EQUIPMENT

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)

FORM J: SUBCONTRACTOR LIST
(See D11)

WINNIPEG WATER TREATMENT PROGRAM – SUPPLY OF POLYMER FEED EQUIPMENT

Name	Address

PART E - SPECIFICATIONS

GENERAL

E1. GENERAL

E1.1 These Specifications shall apply to the Work.

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

Sections

Section	Description
Division 01 – General Requirements	
01300	Polymer Submittals
01400	Polymer Quality Control
01650	Polymer Equipment Installation
01730	Polymer Operation and Maintenance Manuals
Division 11 – Process	
11000	Equipment General Provisions
11060	Process Motors Less Than 150 kW
11300	Process Pump General Requirements
11315	Progressing Cavity Pumps
11346	Polymer Feed System, Dry
11347	Polymer Feed System, Stand-By
11901	Factory Applied Maintenance and Corrosion Protection Coatings
Division 16 – Electrical	
16010	Electrical General Requirements
16015	Scope of Supply
16122	Wires and Cables 0 – 1000 V
16131	Junction Boxes and Pull Boxes
16151	Wire and Box Connectors 0 – 1000 V
16811	Motor Starters to 600 V
16815	Variable Frequency Drives
16825	Control Devices
Division 17 – Instrumentation and Controls	
17010	Instrumentation and Control General Requirements
17110	Enclosures
17124	Instrumentation Cable
17130	Power Supplies
17140	Instrument Air Supply and Transmission
17211	Process Taps and Primary Elements
17212	Transmitters and Indicators
17213	Powered Actuators
17216	Switches and Relays
17271	Signal Conditioning Modules
17274	Panel Instruments
17275	Miscellaneous Panel Devices
17500	Programmable Logic Controllers
17501	Operator Interface Requirements

Drawings

Drawing No.	Description
WC-M0111	Polymer Preparation and Feed Room – General Arrangement – Ground Floor Plan
WC-M0112	Dry Polymer Chemical Storage Room – General Arrangement – Ground Floor Plan
WC-M0121	Polymer Preparation and Feed Room – General Arrangement – Second Floor Plan
WC-M0201	Polymer Preparation and Feed Room – General Arrangement - Section
WC- P0001	Piping & Instrumentation Diagram – Hydrogen Peroxide Storage – Chemical Feed Area
WC-P0002	Piping & Instrumentation Diagram – Hydrogen Peroxide and Chemical Feed Systems – Chemical Feed Area
WC-P0003	Piping & Instrumentation Diagram – Sodium Bisulphite Offloading and Storage – Chemical Feed Area
WC-P0004	Piping & Instrumentation Diagram – Sodium Bisulphite Chemical Feed Systems – Chemical Feed Area
WC-P0005	Piping & Instrumentation Diagram – Dry Polymer Bulk Bag Unloading & Conveyance – Chemical Feed Area
WC-P0006	Piping & Instrumentation Diagram – Polymer Preparation Systems DAF/Filter – Chemical Feed Area
WC-P0007	Piping & Instrumentation Diagram – Polymer Preparation Systems Residuals – Chemical Feed Area
WC-P0008	Piping & Instrumentation Diagram – Polymer Feed Tanks DAF/Filters – Chemical Feed Area
WC-P0009	Piping & Instrumentation Diagram – Polymer Feed Tanks Residuals – Chemical Feed Area
WC-P0014	Piping & Instrumentation Diagram – Polymer Filter Feed Pumps – Chemical Feed Area
WC-P0015	Piping & Instrumentation Diagram – Polymer Sludg Feed Pumps – Chemical Feed Area
WC-P0016	Process Flow Diagram – Water Treatment Plant Overview – General Siteworks
WM-P0001	Construction Standards – Instrumentation and Process - Identification
WM-P0002	Construction Standards - Process And Instrumentation - Symbols

E2. GOODS

E2.1 The Contractor shall supply Polymer Feed Equipment in accordance with the requirements hereinafter specified.

POLYMER 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.

.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.

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

1.5 Product Data

.1 Product Data; Manufacturer's catalogue sheets, brochures, literature, performance charts, and diagrams used to illustrate standard manufactured products.

.2 Submit six (6) copies of product data.

.3 Sheet size: 215 x 280 mm.

1.6 Electronic Submittals

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

1.7 Shop Drawing Review

.1 Shop Drawing review by the Contract Administrator is solely to ascertain conformance with the general design concept. Responsibility for the approval of detail design inherent in Shop Drawings rests with the Contractor and review by the Contract Administrator shall not imply such approval.

.2 Review by the Contract Administrator shall not relieve the Contractor of his responsibility for errors or omissions in Shop Drawings or for proper completion of the Work in accordance with the Contract Documents.

.3 Shop Drawings will be returned to the Contractor with one of the following notations:

.1 When stamped "REVIEWED", distribute additional copies as required for execution of the Work.

.2 When stamped "REVIEWED AS MODIFIED", ensure that all copies for use are modified and distributed, same as specified for "REVIEWED".

.3 When stamped "REVISE AND RE-SUBMIT", make the necessary revisions, as indicated, consistent with the Contract Documents and submit again for review.

.4 When stamped "NOT REVIEWED", submit other drawings, brochures, etc. for review consistent with the Contract Documents.

.5 Only Shop Drawings bearing "REVIEWED" or "REVIEWED AS MODIFIED" shall be used on the Work unless otherwise authorized by the Contract Administrator.

.4 After submittals are stamped "REVIEWED" or "REVIEWED AS MODIFIED", no further revisions are permitted unless re-submitted to the Contract Administrator for further review.

.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.

END OF SECTION

POLYMER 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.

.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.

.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

POLYMER EQUIPMENT INSTALLATION

1. INTENT

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

2. EXPERTISE AND RESPONSIBILITY

.1 The Contract Administrator recognizes the expertise of the Contractor and the Manufacturer.

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

3. EQUIPMENT DELIVERY

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

4. INSTALLATION ASSISTANCE

.1 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 of the equipment prior to commencing installation of equipment.

.2 The Contractor shall inform the Contract Administrator, in writing, of the attendance at the Site of any Manufacturer's Representative for installation training at least fourteen (14) days prior to arrival.

.3 When the Manufacturer's Representative is satisfied that the 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.

5. INSTALLATION

.1 If necessary, or if so directed by the Contract Administrator during the course of installation, the Installer shall contact the Manufacturer to receive clarification of installation procedures, direction, or any other additional information necessary to continue or complete the installation in an appropriate manner.

.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 mm 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 the entire 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 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. All testing shall conform to the project schedule as directed by the Contract Administrator.

.3 All operation and performance verification testing shall conform to the project master schedule.

.4 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.

.5 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.

.6 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.

.7 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.

.8 The equipment shall then be run for one (1) hour. 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.

.9 On satisfactory completion of the one (1) hour demonstration, the equipment shall be stopped and critical parameters, such as alignment, shall be rechecked.

.10 The equipment shall be restarted and run continuously for five (5) days. 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.

.11 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. 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.

.12 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.

.13 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.

.14 All water, 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. Chemicals including dry polymer and liquid emulsion are to be provided by the City.

.15 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.

.16 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.

.17 When the Contract Administrator confirms all unit processes in the plans are tested as per Form 103 and training provided as per Form T1, the twenty-eight (28) day commissioning period shall commence. The equipment shall operate 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.

.2 The training sessions shall last two (2) days each. The training sessions shall be given twice, to allow the City’s staff to attend either session. The training sessions shall be given during

the three (3) week period preceding the start of the 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 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.

.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.

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

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

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

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

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

POLYMER 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.

.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

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.

.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.

.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 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.

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 of Winnipeg 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 chloramination. The purpose of this tender document is to select and pre-purchase the Polymer Feed 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 and Drawings shall be submitted at the time of submittal.

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).

.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.

.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.

1.5 Quality Assurance

.1 Costs: Pay all costs of inspection, 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.

.3 Machine Finish: The type of finish shall be the most suitable for the application and shall be shown in micro-inches in accordance with ANSI B46.1. The following finishes shall be used:

.1 Surface roughness not greater than 63 micro-inches shall be required for all surfaces in sliding contact.

.2 Surface roughness not greater than 250 micro-inches shall be required for surfaces in contact where a tight joint is not required.

.3 Rough finish not greater than 500 micro-inches 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 micro-inches.

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
Blowers		
centrifugal or vane	1.0	Uniform
lobe	1.25	Moderate Shock
Pumps		
centrifugal or rotary	1.0	Uniform
progressing cavity	1.0	Uniform
Mixers		
Mixer/agitator	1.25	Moderate Shock

.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.

.5 Where load classifications are not indicated, service factors based on 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 - Instrumentation.

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 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 Manitoba, unless otherwise indicated.

2.3 Couplings

.1 Mechanical couplings shall be provided between the driver and the driven equipment. Flexible couplings shall be provided between the driver and the driven equipment to accommodate slight angular misalignment, parallel misalignment, end float, and to cushion shock loads. Unless otherwise indicated or recommended by the Manufacturer, coupling type shall be furnished with the respective equipment as follows:

Equipment Type	Coupling Type
Horizontal and end suction pumps	Gear or flexible spring
Single stage centrifugal blowers	Flexible disc pack

.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 two (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.

.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 & 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 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.

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.

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 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.

2.10 Piping Connections

.1 Pipe Hangers, Supports, and Guides: Pipe connections to equipment shall 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.

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.

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 the number of days indicated in Section 01650 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 to instruct the City's personnel in the 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 Manufacturer’s 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 completing and issuing Form 103. Any equipment not within the specified limits shall be repaired.

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 LESS THAN 150 KW

1. GENERAL

1.1 Description

.1 Alternating current induction motors, 150 kW or less, National Electrical Manufacturers Association (NEMA) frame type.

.2 Unless specified otherwise, electric motors to be provided by the Manufacturer of the driven equipment, as an integral component of the driven equipment.

.3 Motors suitable for starting, accelerating, and running centrifugal pumps, fans, blowers, compressors, gears, progressive cavity pumps, or other loads fed via across the line starters, or variable frequency drive (VFD) as noted in the equipment data sheets.

1.2 Reference Standards

.1 Conform to the following reference standards:

.1 Canadian Standards Association (CSA) C22.2 No. 100, Motors and Generators.

.2 CSA C22.2 No. 145, Motors and Generators for Use in Hazardous Locations.

.3 CSA C390, Energy Efficient Test Methods for Three Phase Induction Motors.

.4 NEMA M1-7, Motors and Generators.

.5 NEMA M2.1, Standard for Lead Marking and Connections for Single Phase and Polyphase Induction Motors.

.6 Statutes of Canada, Energy Efficiency Act (most recent revision).

.7 Statutes of Canada, Energy Efficiency Regulations.

.8 Institute of Electrical and Electronic Engineers (IEEE) 112, Standard Test Procedure for Polyphase Induction Motors and Generators.

.9 IEEE 114, Standard Test Procedures for Single-Phase Induction Motors.

.10 IEEE 841, Standard for Petroleum and Chemical Industry – Severe Duty Totally Enclosed Fan-Cooled (TEFC) Squirrel Cage Induction Motors, Up to and including 500 horsepower (370 kW).

.11 NEMA MG1, Motors and Generators.

1.3 Submittals

.1 Shop Drawings: Submit with the related items of equipment in accordance with **Sections 11300, 11315, 11346, 11347.** In addition, submit the following details: Provide the specified information for each typical size or type of motor driven equipment.

.1 Overall dimensions of motor.

.2 Shaft centreline to base dimension.

.3 Shaft extension diameter and keyway, coupling dimensions and details.

.4 Fixing support dimensions.

.5 Terminal box location and size of terminals.

.6 Arrangement and dimensions of accessories.

.7 Diagram of connections.

.8 Speed/torque characteristic.

.9 Weight of motor.

.10 Installation data.

.11 Rotation direction.

.12 Starting restrictions (time between starts).

.13 Terminal leads marking.

.14 Bearing data (including part numbers).

.15 Recommended lubricant.

.16 Design ambient temperature and temperature rise ratings.

.17 Torque characteristics including rated starting torque and breakdown torque.

.18 The American Bearing Manufacturers Association (ABMA) L-10 rated life for the motor bearings.

.19 The nominal efficiency for all motors.

.20 Class, zone, group and Underwriters Laboratories Inc. (UL) frame temperature limit code for explosion-proof motors.

1.4 Service Conditions

.1 Unless specified otherwise, provide motors suitable for continuous operation at an elevation of 300 m above sea level.

.2 Provide motors suitable for continuous operation in a 40°C ambient temperature.

1.5 Coordination

.1 For motors fed via VFD's, communicate motor requirements to and comply with drive requirements of the Manufacturer of the VFD.

.2 Motors powered via VFDs shall be rated for use with VFDs.

1.6 Quality Assurance

.1 Build motors in accordance with CSA C22.2 No. 100, CSA C22.2 No. 145, NEMA Standard MG1, IEEE 841 and to the requirements specified.

1.7 Shipment, Protection and Storage

.1 Ship, protect, and store equipment in a manner that prevents damage or premature aging.

.2 Handle motors with suitable lifting equipment.

.3 Store motors in heated, dry, weather-protected enclosure.

2. PRODUCTS

2.1 Approved Manufacturers

.1 GE.

.2 Westinghouse.

2.2 Materials

.1 Motors: to Electrical and Electronic Manufacturers of Canada (EEMAC) M1-7.

.2 Lead markings: to EEMAC M2-1.

.3 Unless specified otherwise, provide all motors with:

.1 Frame Cast iron, steel, or cast aluminum.

.2 Endplates Cast iron or cast aluminum.

.3 Terminal boxes Cast iron, steel, or cast aluminum.

.4 Fan blades and shrouds Non metallic, corrosion resistant.

.5 Hardware Stainless steel.

.6 Windings Copper, with non-hygroscopic insulation.

2.3 Motor Efficiency

.1 Use high efficiency motors with minimum guaranteed full-load efficiencies listed for NEMA Design E Table 12 – 11 for the size and type of motor provided.

.2 Use vertical motors with efficiency within 0.5% of minimum values stated for horizontal motors.

2.4 Horizontal and Vertical Motors, 0.56 to 150 kW

.1 General

.1 Unless otherwise specified, motors 0.56 to 150 kW to be three (3) phase, squirrel cage induction type, full voltage start, high efficiency, with copper windings.

.2 Service factor of 1.15 at 40°C ambient.

.3 Rated for 600/3/60 VAC service unless otherwise specified.

.4 Design motors for full voltage starting, capable of running successfully when terminal voltage is from +10% to –10% of nameplate voltage and terminal frequency is from + 5% to – 5% of nameplate frequency.

.5 Capacity sufficient to operate the driven load and associated devices under all conditions of operation without overloading.

.6 Design motor so that it is able to be re-started once after an immediate trip, after coasting to rest; and subsequently at sixty (60) minute intervals. This condition might apply whether the motor was run between starts or whether it was shut down immediately after start and not run between successive starts.

.2 Torque Requirements

.1 Provide motors capable of developing 150% of NEMA Design B locked rotor and pull-up torques with 100% of rated voltage applied and capable of developing in excess of NEMA locked rotor torque values at 90% of rated voltage.

.3 Inertia Loading

.1 Design motors to be capable of 200% of inertia loading values indicated in MG1-12.50, Table 12.3.

.4 Insulation

.1 Use Class F insulation

.2 Design motor for temperature rise less than 90°C at 1.15 service factor loading.

.3 Insulation to be non-hygroscopic.

.5 Varnish

.1 Dip and bake in Class H varnish a minimum of two (2) times. For 284T and larger frames, dip and bake a minimum of three (3) times.

.6 Current Imbalance

.1 Do not exceed the values tabulated below when the motor is operating at any load within its service factor rating and is supplied by a balanced voltage system:

.1 Under 37.5 kW: 25%.

.2 37.5 kW and above: 10%.

.2 Base imbalance criteria upon the lowest value measured.

.7 Winding Over-Temperature Protection

.1 Provide stator winding over-temperature protection on all motors rated 37 kW and larger. Motors rated less than 45 kW to have stator winding over-temperature protection when required by the specific equipment Specification Section or if recommended by the driven equipment Manufacturer.

.2 Over-temperature protection for motors rated 37 kW and larger and other motors, where specified, to be NEMA MG1-12.53, Type 1, winding running and locked rotor over-temperature protection. One detector to be provided per phase. Detectors to be positive thermal protection (PTC) thermistor type, with leads brought out to a terminal strip in a NEMA 4 enclosure in Type two (2) motors and a NEMA 7C or 9 enclosure for Type three (3) motors.

.8 Bearings

.1 Select type of bearings on basis of torque and thrust requirements.

.2 Provide anti-friction bearings with grease lubrication, with one (1) year continuous operation without re-greasing.

.3 Provide sealed ball or cylindrical roller bearing type on motors less than 37.5 kW.

.4 Bearings on 37.5 kW motors or larger to be greasable ball bearing type, rated for a minimum L-10 life of 100,000 hours at the ambient temperature specified herein.

.5 Design bearings to have a maximum 45°C temperature rise at rated horsepower for four (4) pole and greater motors and 50°C for two (2) pole motors.

.6 Provide features to minimize the entrance of moisture and contaminants into the bearing chamber.

.9 Mounting

.1 End-bell mounted bearings: Provide motor sole plates, machined top and bottom, with a minimum thickness of 50 mm depending upon motor size.

.2 Pedestal type, independent of stator frame: Provide fabricated structural steel base, suitably braced to prevent distortion, to mount the stator frame and the bearing pedestals.

.3 Provide vertically mounted motors with drip shield.

.10 Direction of Rotation

.1 Design the motor so that it is capable of running in either direction of rotation by reconnecting the motor terminals.

.11 Frame

.1 Use a minimum of grade 25 cast iron, aluminum, or steel for frame, end brackets, fan cover, and conduit box. Refer to motor classifications.

.2 Provide two (2) bronze automatic breather drains at the lowest point in the motor frame.

.3 On frames sizes greater than 180, provide removable lifting eyes at the balance point of the motor, with a design safety factor greater than ten (10). Vertical motors require two (2) eyes, one (1) on each side of the frame.

.4 Use stainless steel hardware.

.12 Motor Classifications:

.1 Type 1 (General Duty): Unless specified otherwise, TEFC enclosures.

.2 Type 2 (Process): TEFC, suitable for moist and corrosive environment. All internal surfaces to be coated with an epoxy paint.

.3 Type 3 (Explosion-proof): Motors to be rated for operation in a Class 1, Zone 1, Group D hazardous location in accordance with CSA C22.1. Provide an approved breather/drain device to be provided in the motor drain hole.

.4 Type 4 (Exterior): TEFC or weather protected. All internal surfaces to be coated with an epoxy paint.

.13 Cooling Fans

.1 Fabricate external cooling fans of non sparking, corrosion resistant material.

.14 Terminal Box

.1 Incorporate an oversize terminal box with a volume greater than NEMA requirements, rotatable in 90° increments. Provide gaskets between the terminal box and frame and between the terminal box and cover.

.2 Provide diagonally split, gasketted, EEMAC 4 terminal boxes complete with threaded hub for conduit entry for open drip proof (ODP) and TEFC motors and adequately sized, diagonally split, gasketted EEMAC 7 terminal boxes complete with threaded hub for conduit entry for explosion-proof motors.

.3 Provide a ground connection and lugs in the terminal box.

.4 Provide a separate terminal box for all motors required to have internal monitoring devices c/w terminal blocks.

.15 Vibration and Critical Speed

.1 Align and balance motors in the factory.

.2 Measure displacement horizontally and vertically in accordance with Canadian Electrical Manufactures Association (CEMA) Standard M1-20.58 and 20.59. Balance so that measured values are less than the following:

Nominal Running Speed (rpm)	Amplitude (mm)
3,600	0.0125
1,800	0.0175
1,200 and under	0.025

.3 Ensure that axial vibration, as measured at the bearing housings, does not exceed twice the above values.

.16 Motors are to be aligned and balanced with the related equipment in the Shop to minimize vibration and undue stresses. Maximum vibration of motor at the bearing housing is 12.5 microns peak to peak. As necessary, provide stainless steel balance washers.

.17 Sound pressure levels at 1.0 m, free field:

.1 93 kW (125 hp) and larger two (2) pole motors 90 dBA

.2 All other motors 85 dBA

.18 Where specified, equip motors with anti-condensation heaters suitable for connection to 120 volts, single phase, 60 Hz.

.19 Finishes

.1 Factory prime and paint in accordance with **Section 11901**.

.2 On interior of motor, apply rust inhibiting coating on all exposed machined surfaces.

2.5 Motors Smaller Than 0.56 kW

.1 General

.1 Unless otherwise specified, motors smaller than 0.56 kW to be squirrel cage, single phase, capacitor start, induction run type with copper windings.

.2 Construction features listed in this Section may be as normally supplied by the Manufacturer.

.3 Single phase motors to have Class F insulation.

.4 Small fan motors may be split-phase or shaded pole type.

.5 Provide copper windings.

.2 Rating

.1 Unless specified otherwise, motors to be rated for operation at 115/1/60 VAC, and continuous-time rated in conformance with NEMA Standard MG1, paragraph 10.35.

.3 Enclosures

.1 Unless otherwise specified, provide motors with TEFC or totally enclosed non-ventilated enclosures.

.2 Explosion-proof motors shall be approved by CSA for hazardous locations.

.3 Provide an over-temperature device in the enclosure to detect and automatically alarm to SCADA.

2.6 Motors for Variable Frequency Drives

.1 Select high efficiency units, inverter duty rated, CSA certified to be in conformance with NEMA MG1, Part 30 and Part 31.

.2 Design to ensure turndown of five (5): one (1) unless specified elsewhere.

.3 Use Type two (2) or Type three (3) motors.

.4 Insulation: Class F insulation, suitable for 90°C temperature rise, with a 1.0 safety factor, suitable for moist and corrosive environments and in accordance with NEMA MG1 Part 30 and Part 31. Provide additional treatment at winding end turns to minimize stray current failures.

.5 Design motors for variable frequency systems so that they are not required to deliver more than 80% of the motor's power rating by any load imposed by the driven machine at any specified operating condition or any condition imposed by the driven machine's performance curve at maximum operating speed.

.6 Ensure motors have adequate cooling capacity when operating through the entire speed range capacity of the drive.

.7 Enclosure and other insulation requirements are the same as required for constant speed motors.

2.7 Vertical Motors

.1 Unless otherwise specified, provide full voltage vertical motors with a Type P base specifically designed for vertical installation.

.2 Universal position motors are not acceptable.

.3 Provide vertical motors with solid shafts unless specified otherwise.

.4 Provide thrust bearing rating compatible with the loads imposed by the driven equipment.

2.8 Two Speed Motors

.1 Not used.

2.9 Power Factor Correction Capacitor Sizing

.1 The motor vendor to confirm the maximum capacitor size which may be connected to motors 7.5 kW and larger, on constant speed drives.

2.10 Motor Mounting

.1 Where equipment is specified to include C-Flange mounting, make motors compatible with this joining and alignment technique.

2.11 Finishes

.1 In accordance with **Section 11901.**

2.12 Equipment Identification

.1 Provide equipment identification in accordance with Division 11 and Division 16.

.2 Nameplates

.1 Provide motor nameplates on engraved or stamped stainless steel. Include information enumerated in NEMA Standard MG1, paragraph 10.37, 10.38 or 20.60, as applicable.

.2 Additionally, indicate:

.1 The ABMA L-10 rated life for the motor bearings for motors 37.5 kW and larger.

.2 The nominal efficiency for all motors.

.3 Class, Zone, group and UL frame temperature limit code for explosion-proof motors.

.4 Permanently fasten nameplates to the motor frame and position to be easily visible for inspection.

2.13 Spare Parts

.1 Provide maintenance materials and spare parts in accordance with **Section 11000**.

3. EXECUTION

3.1 Testing

.1 Perform tests and document results in accordance with Division 16.

.2 Test motor efficiency in accordance with CSA C390 and NEMA MG1, accounting for stray load losses, measured indirectly based on the IEEE method. Stamp efficiency on the motor nameplate.

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 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

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 defined by the pump supplier 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 and 11000. For all pump Shop Drawings in addition to the requirements of Section 11000, 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. 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.

1.4 Delivery and Storage

.1 Prior to delivery, ensure that the Certificate of Readiness (Form 101) is completed to ensure that the Installer is ready to receive the specified equipment.

.2 Ship pre-assembled to the degree that is possible. Inform Installer 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 as defined for the low head point.

.5 Supply pumps capable of operating at 30% of the flow at the rated capacity with good efficiency without exceeding the motor horsepower and capable of operating at any point on its characteristic curve, to where that curve intersects the low head point, without exceeding motor power rating.

2.2 Pressure Sensing

.1 Supply a means of measuring inlet and outlet pressure with each pump, except as noted.

.2 For centrifugal pumps handling clean water, supply gauges for the inlet and outlet of each pump.

.3 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.

.4 For centrifugal pumps handling effluent water, supply one (1) pressure sensor and one (1) gauge for each pump. Mount on valved pipe that extends from inlet to outlet of pump, with a connection for flushing water.

.5 Gauges

.1 Supply gauges that are 100 mm diameter, 13 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.

.6 Pressure Sensors

.1 Supply annular ring, flow through type pressure sensors, with stainless steel body, a sensing element compatible with the corrosive and abrasive nature of the fluid being measured, 25 mm diameter.

.2 Acceptable Products: Red Valve Series 42 or Robbins and Myers RKL Series W.

.3 Provide stainless steel nipples extending to a tee from the pressure sensor. Mount the gauge on one leg of the tee. If a pressure indicator/transmitter/switch is shown on the Drawings, mount on the other side of the tee. Otherwise, plug the tee.

.4 Supply annular type pressure sensors with their initial fill of fluid.

2.3 Pump Seals

.1 Provide double mechanical seals, unless otherwise noted in the Specifications of the particular pump.

.2 Single mechanical seals can be used only where 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 316L Stainless Steel	316 or Hastelloy C	Buna-N or Viton	Silicon Carbide on Carbon

.6 Provide connections for cooling/flushing water.

.7 Approved Manufacturers are:

.1 Durametalic.

.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**.

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.

.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.

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 for one spare mechanical seal or packing kit (as applicable) and one (1) set of pump bearings.

.2 For each centrifugal pump type and size, provide a single impeller, wear plate, suction ring (if replaceable), one pump shaft and nut.

.3 For spare parts for positive displacement pumps, provide as a minimum, one (1) wearing element. Refer to related pump Specifications for the specific spare part requirements.

2.13 Factory Performance Testing

.1 Where required for specific pumps, as noted in the Sections related to those pumps, factory performance test all pumps.

.2 Conduct factory performance testing in compliance with the Hydraulic Institute Standards.

.3 Inform Contract Administrator at least three (3) weeks prior to the factory testing to allow for his attendance.

.4 Certify test results and summarize findings in a short report. Submit report to the Contract Administrator within three (3) weeks of completing factory tests.

.5 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.

.6 Do not ship the pump(s) until the test result report has been submitted to the Contract Administrator.

2.14 Finishes

.1 Factory prime 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 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 The Installation Contractor will field test all pumps greater than or equal to 3.7 kW, and smaller units where noted, to verify performance. The Contractor will record the results of the testing and provide as required, clarification of testing procedures, or any additional information necessary to complete testing in an appropriate manner. T

.2 The Installation Contractor will provide temporary connections, flow monitoring, pressure monitoring, ammeters, and temporary tankage required for the performance of the tests.

.3 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 runout.

.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.

.4 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.

.5 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.

.6 For variable speed pumps, conduct the tests at two (2) speeds, typically 100% of the design speed and 30% of the design speed.

.7 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.

.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.

.8 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

PROGRESSING CAVITY PUMPS

1. GENERAL

1.1 References

.1 Pumps shall be in compliance with the appropriate sections of the following codes:

.1 NSF International, Standard 61 - Drinking Water System Components.

.2 American Gear Manufacturers Association (AGMA).

.3 American Institute of Steel Construction (AISC).

.4 American Iron and Steel Institute (AISI).

.5 American Bearing Manufacturers' Association (ABMA).

.6 American Society of Mechanical Engineers (ASME).

.7 American National Standards Institute (ANSI).

.8 American Society for Testing and Materials (ASTM).

.9 Canadian Electrical Code (CEC).

.10 Canadian Standards Association (CSA).

.11 Electrical and Electronic Manufacturers Association of Canada (EEMAC).

.12 Electrical Safety Authority (ESA).

.13 Instrument Society of America (ISA).

.14 National Electrical Code (NEC).

.15 National Fire Protection Association (NFPA).

.16 Steel Structures Painting Council (SSPC).

.17 Manitoba Building Code.

.18 Canadian Plumbing Code (CPC).

.19 Occupational Safety & Health Act (OSHA).

1.2 Contractor Submittals

.1 Shop Drawings:

.1 Make, model, weight, and horsepower of each equipment assembly.

.2 Complete catalog information, descriptive literature, Specifications, and identification of materials of construction.

.3 Performance data curves showing head, capacity, horsepower demand, and pump efficiency over the entire operating range of the pump, from shutoff to maximum capacity. Indicate separately the head, capacity, horsepower demand, overall efficiency, and minimum submergence required at the guarantee point.

.4 Pump maximum downthrust or upthrust in pounds.

.5 Detailed Drawings showing the equipment dimensions, size, and locations of connections and weights of associated equipment.

.6 Power and control wiring diagrams, including terminals and numbers.

.7 Complete motor nameplate data, as defined by NEMA, motor Manufacturer, and including any motor modifications.

.8 Factory finish system.

.9 Size, length and spacing of anchor bolts or attachment to the foundations or supports.

.10 External utility requirements air, water, power, etc for each component.

.2 Quality Control Submittals:

.1 Factory Functional and Performance Test Reports.

.2 Manufacturer's Certification of Compliance that the factory finish system is identical to the requirements specified herein.

.3 Special shipping, storage and protection, and handling instructions.

.4 Manufacturer's printed installation instructions.

.5 Manufacturer's Certificate of Proper Installation.

.6 Suggested spare parts list to maintain the equipment in service for a period of five (5) years. Include a list of special tools required for checking, testing, parts replacement, and maintenance with current price information.

.7 List special tools, materials, and supplies furnished with equipment for use prior to and during startup and for future maintenance.

.8 Operation and maintenance (O&M) manual.

1.3 Required Spare Parts and Special Tools

.1 Furnish for each size of pump:

.1 One (1) complete set of packing.

.2 One (1) complete set of bearings.

.3 One (1) complete set of gaskets and O-ring seals.

.4 One (1) complete of set of rod washers.

.5 One (1) complete set of keys, dowels, pins, etc.

.6 One (1) stator.

.7 One (1) rotor.

.8 One (1) connecting rod with pair of universal joint(s), as required by pump type.

.9 One (1) complete set of any special tools required to dismantle pump.

2. PRODUCTS

2.1 General

.1 Approved Equipment Manufacturers:

.1 Moyno

.2 Seepex

.2 Coordinate pump requirements with drive Manufacturer and be responsible for pump and drive requirements.

.3 Where adjustable speed drives are required, furnish a coordinated operating system complete with pump, drive, and speed controller.

2.2 Pump Design

.1 General

.1 Pumps shall have materials of construction selected for resistance to the pumped solution. For pumped solutions of non-corrosive materials, pump materials of construction shall be either Type 316 stainless steel and Viton. Each pump shall be a heavy-duty universal pin type. The pump and drive shall be mounted on a structural steel base plate complete with a drip rim, drainage connection, and suitable guards.

Each pump shall have a minimum two-stage rotor to minimize slip and provide greater linearity.

.2 Suction and discharge nozzles shall have ANSI 125 pound flanges. Each pump shall be supplied with single-acting non-flushing mechanical seals.

.3 Each metering pump shall be equipped with a 600 V, 3-phase inverter duty motor.

.4 Pumps to be factory finished. Contractor shall prime and touch up damaged finishes to match original finish. Restore to new finishes that have been damaged too extensively to prime and touch up.

.5 Each progressive cavity pump shall be provided with appropriate inputs and outputs to facilitate control from the supplier PLC.

.2 Motor Starters and Drive Unit

.1 Supply motors in accordance with requirements of Division 11060 - Polymer_Process Motors Less Than 150 kW.

.2 Drive shall have the following features:

.1 Provide a single helical rotor of circular cross section, fabricated from 316 stainless steel. The rotor shall be driven in its path by either a positively sealed universal joint, or a sealed gear joint design.

.2 Provide a Buna-Nitrile stator, chemically bonded to the inside of a steel tube. Stators shall be manufactured to length. Stators manufactured in long lengths and cut to size are not acceptable.

.3 Mount pump and motor in-line along with associated drive appurtenances on a one-piece, fabricated steel baseplate with full drip lip, grout holes, drains, guard, shims, and accessories.

.4 Provide pumps with single-acting non-flushing mechanical seals.

.5 For each pump, provide a liquid filled ring-type pressure gauge and switch with hardwired interlock to the VFD. The VFD shall trigger a general alarm on shutdown due to high pressure, after appropriate time delay.

.6 For VFD driven units, pump Manufacturer is responsible for the provision of the gear reducer between the motor and pump.

.7 Reduction ratio as required to operate the pump at its maximum operating speed when the motor is operating at its nominal rated full speed in accordance with Specifications.

.8 Pumps are gear driven, with variable speed drive.

.9 Provide gear motors or gear reducers.

.10 Gear reducer drive equipment designed to transmit 150% of the maximum torque under the full range of operating conditions.

.11 Each progressing cavity pump shall be supplied with a stator heat sensor with hardwired interlock to the VFD. The VFD shall trigger a general alarm on shutdown due to high temperature.

.3 Motor

.1 Suitable for use with variable frequency drive per NEMA MG1-31.

.2 Rated 600V, 3 phase, 60 Hz.

.3 Totally enclosed fan cooled (TEFC).

.4 External fan cooling. Fan to be independent of motor speed with own power supply

.5 Premium efficiency.

.6 1.15 service factor.

.7 Continuous duty.

.8 Class F Insulation.

.9 Speed as required to suit gear reducer and pump.

2.3 Accessories

.1 Equipment Identification Plate: 16-gauge stainless steel with 6 mm die-stamped equipment tag number securely mounted in a readily visible location.

.2 Lifting Lugs: Equipment weighing over 45 kg.

.3 Anchor Bolts: Type 316 stainless steel, 13 mm minimum diameter.

2.4 Factory Finishing

.1 Factory prime all finishes in accordance with Section 11901 – Factory Applied Maintenance and Corrosion Protection Coatings.

3. EXECUTION

3.1 Manufacturer's Representative

.1 A Manufacturer's Representative is to attend the Site prior to the arrival of the equipment to train the Installer and ensure a seamless custody transfer.

.2 A Manufacturer's Representative shall attend the Site to witness installation and testing to ensure the equipment is installed and operated as intended.

3.2 Installation Training

.1 Instruct the Installer in the methods and precautions to be followed in the installation of the pump(s).

.2 The Manufacturer's Representative shall verify the Installer’s understanding by completing Form 101 as shown in Section 01650 – Equipment Installation.

3.3 Testing

.1 Ensure that each pump, including all component parts, operates as intended.

.2 Cooperate with the Installer to fulfill the requirements for successful testing of the equipment, as documented by Form 103, illustrated in Section 01650 – Equipment Installation.

.3 Refer to Section 11300 – Process Pump General Requirements for testing requirements.

3.4 Commissioning

.1 Attend performance and installation testing of the pumps specified in this Section to ensure that each pump functions as intended within the process system.

END OF SECTION

1. GENERAL

1.1 References

.1 The unit shall be in compliance with the appropriate sections of the following codes:

.1 NSF International, Standard 61 - Drinking Water System Components.

.2 American Gear Manufacturers Association (AGMA).

.3 American Institute of Steel Construction (AISC).

.4 American Iron and Steel Institute (AISI).

.5 American Society of Mechanical Engineers (ASME).

.6 American National Standards Institute (ANSI).

.7 American Society for Testing and Materials (ASTM).

.8 Canadian Electrical Code (CEC).

.9 Canadian Standards Association (CSA).

.10 Electrical and Electronic Manufacturers Association of Canada (EEMAC).

.11 Electrical Safety Authority (ESA).

.12 Institute of Electrical and Electronics Engineers (IEEE).

.13 Instrumentation, Systems and Automation Society (ISA).

.14 National Electrical Code (NEC).

.15 National Fire Protection Association (NFPA).

.16 National Electrical Manufacturers Association (NEMA).

.17 Steel Structures Painting Council (SSPC).

.18 Manitoba Building Code.

.19 Canadian Plumbing Code (CPC).

.20 Occupational Safety & Health Act (OSHA).

1.2 Contractor Submittals

.1 Shop Drawings:

.1 Make, model, and weight of each equipment assembly.

.2 Complete catalog information, descriptive literature, Specifications, and identification of materials of construction.

.3 Detailed mechanical Drawings showing the equipment location and dimensions, size and locations of connections, weights of associated equipment, and construction details.

.4 Performance Specifications of all items of equipment.

.5 Process schematics associated with all items of equipment.

.6 Instrument layout of the control panel.

.7 Power and control wiring diagrams, including terminals and numbers.

.8 Complete motor nameplate data, as defined by NEMA, motor Manufacturer, and including any motor modifications.

.9 Factory finish system.

.10 Size, length and spacing of anchor bolts or attachment to the foundations or supports.

.11 External utility requirements air, water, power, etc for each component.

.2 Submittal of Interface Material: The following materials, defining the interface between the system specified herein and the remainder of the plant, plus any additional information called for in these Specifications, shall be submitted to the Contract Administrator within 90 days following execution of Contract, and prior to any construction or fabrication that requires interfacing with the system.

.1 Identification, description, and envelope dimensions for each separately installed subassembly or piece of equipment and the associated connection dimensions to permit incorporation of the system selected into the design of the plant.

.2 Information on field and installation requirements, including mounting requirements, access, and approximate total weight of each piece of equipment.

.3 A detailed description of the instrumentation and control system, including a list of all functions monitored, controlled and/or alarmed. Describe all automatic shutdown features and interfaces with the plant instrumentation and control systems. The description of the instrumentation and control system shall be in both word and schematic form. Schematics shall be in accordance with the latest edition of NEMA ICS.

.4 Clearly identify the tag name, model numbers and catalogue numbers for each piece of equipment, component, device, etc., within the Product's technical literature. Clearly identify these model numbers using red ink on all of the Manufacturer's technical literature, such as but not limited to, instruction manuals, technical bulletins, and Manufacturer's Specification Sheets (i.e., Manufacturer's Cut Sheets).

.5 All Drawing submittals shall conform to Drawing number and tagging conventions as indicated on the Prides. Submittal Drawing numbers can range from WC-P0005 to WC-P0016. Use same equipment tags as indicated on P&ID on all Drawing submittals.

.6 Electric motor control schematics. Include locations of control stations, and any special control to be provided by others. Coordinate polymer controls with Plant control System.

.7 A complete description of all interfaces between the system components and between the system and other plant components. Provide a summary by interface link for the following:

.1 Number, size, and type of all process and auxiliary connections.

.2 Number, size, and type of electronic or electrical signal wires.

.3 Number, size, and type of electrical power wires.

.8 Control panel envelope dimensions, mounting requirements, and access requirements (doors, louvers, etc.).

.9 Fully commented ladder logic listings, I/O printouts, and cross-reference printouts documenting Programmable Controller software program.

.3 Informational Submittals:

.1 Field Performance Test Report.

.2 Special shipping, storage and protection, and handling instructions.

.3 Manufacturer's printed installation instructions.

.4 Manufacturer's Certificate of Proper Installation.

.5 Suggested spare parts list to maintain the equipment in service for a period of one (1) year. Include a list of special tools required for checking, testing, parts replacement, and maintenance with current price information.

.6 List special tools, materials, and supplies furnished with equipment for use prior to and during startup and for future maintenance.

.7 Operation and Maintenance (O&M) Manuals: As specified in Section 01730, Operation and Maintenance Manuals.

.8 As specified in Division 17.

1.3 Preparation for Shipment

.1 Insofar as is practical, equipment specified herein shall be factory assembled and tested. Parts and assemblies that are of necessity shipped unassembled shall be packaged and tagged in a manner that will protect equipment from damage and facilitate final assembly in the field. Machined and unpainted parts shall be protected from damage by elements with application of a strippable protective coating.

1.4 Required Spare Parts and Special Tools

.1 Spare parts shall be shipped in a wooden box and shall be protected from damage, from moisture and dirt accumulation. Parts shall be protected as for an extended storage period. The box shall be heavily constructed with hinged cover, hasp, and lock, and designed as a permanent storage enclosure for the spare parts. The spare parts shall, if possible, be enclosed within an airtight membrane. Spare parts supplied in matched sets, such as drive belts, shall be wrapped, bound, or labeled to indicate a set.

.2 Furnish one (1) year supply of lubricants including oil and greases, as recommended by the Product Manufacturer. The lubricants shall include summer and winter grades along with alternative references to equal Products of other Manufacturers including Specifications such as AGMA numbers, viscosity.

.3 Furnish for each piece of equipment

.1 One (1) complete set of packing.

.2 One (1) complete set of bearings.

.3 One (1) complete set of gaskets and O-ring seals.

.4 One (1) complete of set of rod washers.

.5 One (1) complete set of keys, dowels, pins, etc.

.6 One (1) stator for each type of pump, if required

.7 One (1) rotor for each type of pump, if required

.8 One (1) connecting rod with pair of universal joint(s), if required

.9 One (1) complete set of any special tools.

2. PRODUCTS

2.1 Approved Equipment Manufacturers

.1 Severn Trent

.2 CIBA.

.3 Tomal

2.2 Polymer Bulk Bag Unloading and Conveyance System

.1 The Polymer Bulk Bag Unloading and Conveyance System will convey dry polymer stored in the Dry Polymer Storage Room to the upper level of the Polymer Preparation and Chemical Feed Room. Two (2) Polymer Bulk Bag Unloading and Conveyance Systems shall be provided with one dedicated to the Filter Aid Polymer System and one dedicated to the Sludge Polymer System. The bulk bag unloading system shall have a bulk bag frame with monorail and hoist that will receive bulk bags of dry polymer. A bulk bag lifting yoke suspended by the hoist and trolley system shall support the dry polymer bulk bags during unloading. The bulk bags shall unload its contents to a feed hopper. The bag unloading system shall be complete with bulk bag agitation device to ensure consistent discharge and minimize caking and clogging. The bulk bag interface to the feed hopper shall be designed to provide a dust tight sealed connection. Dry polymer unloaded to the feed hopper shall be conveyed to the Polymer Preparation Room via a pneumatic conveyance system.

.2 Capacities and Performance

.1 Design Criteria

Number of Units (duty)	2
Filter Aid Dry Chemical Feed Transfer Rate (Kg/d)	100
Sludge Dry Polymer Chemical Feed Transfer Rate (Kg/d)	50
Supply Voltage (V/ph/Hz)	600 / 3 / 60

.3 General

.1 All components of the Polymer Bulk Bag Unloading and Conveyance System shall be specifically designed for the intended chemical, and shall be constructed from appropriate corrosion and abrasion resistant materials.

.2 Provide two (2) Polymer Bulk Bag Unloading and Conveyance Systems that will convey dry polymer stored in the Dry Polymer Storage Room to the upper level of the Polymer Preparation and Chemical Feed Room.

.3 The Polymer Bulk Bag Unloading and Conveyance Systems shall use a pneumatic blower system to transfer dry polymer from each unit’s feed hopper to the upper level of the Polymer Preparation and Chemical Feed Room. Size pneumatic blower appropriately to ensure dry polymer can be blown to polymer preparation equipment on upper level of the Polymer Preparation and Chemical Feed Room.

.4 All interconnecting piping and polymer conveyance piping will be supplied by the others.

.5 All components of the storage conveyance systems that come into contact with the dry polymer are to be electrically grounded to prevent static charge buildup.

.4 The Polymer Bulk Bag Unloading and Conveyance System with pneumatic blower shall incorporate the following:

.1 Bulk Bag Handling System

.1 The feeder module shall have a structure with provisions to hang and support up to a 1,500 kg bulk polymer bag. The bulk bag handling assembly shall be provided with overhead rail, trolley and hoist, a support frame and lifting bar. The trolley and hoist shall permit moving and placing the bulk bag in position above a bin discharger. The overhead rail shall extend out from the bulk bag unloader a sufficient distance where the hoist can pick up a bulk bag of polymer placed in front of the containment curb. The bulk bag handling assembly shall be provided with a support frame and lifting bar.

.2 Storage hopper to include an adapter nozzle for dust-tight attachment of bulk bag spout, an adjustable vibrator and a gasketted quick release door for easy access to bag snout. A value shall be provided between the storage hopper and the access door to isolate the bulk bag contents when tying or untying the bulk bag snout.

.3 Storage hopper and all parts in contact with polymer shall be fabricated from stainless steel.

.4 Provide two (2) hoist style bag carriages with a minimum safe working load of 2 metric tonnes constructed from carbon steel and coated with epoxy.

.5 Bulk bag support frame to include load cells and summation module to weigh and transmit a 4 to 20 mA weight signal of the bulk bag to the polymer PLC. The summation module shall support net weight and tare weight calculations. A local NEMA 4 panel shall be provided to house the summation module including local weight display and tare adjustment.

.6 Provide a low-level sensor complete with alarm on the dry polymer storage hopper.

.7 Provide one (1) 1500 mm (w) by 2300 mm (l) access platforms complete with access ladder. Height of platform to be determined by Manufacturer. Access platform to be installed in location as shown on Drawings. Access platform to be constructed from carbon steel and coated with epoxy.

.8 A volumetric screw feeder shall be used to meter dry polymer from the storage hopper to the pneumatic transfer line.

.9 A hopper vibrator shall be provided on the lower portion of the hopper to prevent bridging. The screw feeder housing and hopper shall be of stainless steel construction.

.10 The feeder and hopper materials in contact with dry polymer shall be of stainless steel construction.

.2 Dry Polymer Conveyance

.1 A regenerative type low-pressure blower shall be provided to pneumatically convey the dry polymer to the wetting unit via a transport pipe. The transport pipe shall be constructed of stainless steel complete with long radius elbows supplied by others.

.2 The blower shall be designed for continuous operation. The blower shall be equipped with a TEFC 600/3/60 motor. Control of the blower shall be interlocked with that of the polymer blending unit.

.3 The dry polymer feeder shall discharge into an enclosed stainless steel feeder. The feeder shall be heated to prevent condensation and moisture from forming. From the feeder, dry polymer shall be pneumatically conveyed through stainless steel tubing to the wetting unit atop the mix tank. Feed conveyance shall be a completely closed system to prevent drifting of airborne polymer dust and polymer spills in the event of a malfunction.

.4 A level sensor shall be provided in the feed funnel to indicate a high polymer alarm.

.3 Anchor Bolts and Inserts

.1 All assembly bolts, anchor bolts, nuts, and washers shall be 316 stainless steel if wetted (including high humidity or areas subject to spray) and galvanized steel if non-wetted. Supplier to ensure compatibility of dissimilar materials.

2.3 Polymer Preparation Equipment

.1 The fully automatic Polymer Preparation Systems shall be capable of wetting, diluting and aging polymer solutions from 0.1% to 0.5%. Dry Polymer will be delivered in 400 to 1000 kg bags as supplied by chemical suppliers. The Polymer Preparation Systems must capable of preparing long chain polymers without imparting excessive shear. Mixed polymer shall be free of polymer clots and fish eyes.

.2 An emulsion polymer system shall be included as an emergency stand-by unit as specified in Section 11347, Polymer Feed Systems, Standby.

.3 Capacities and Performance

.1 Design Criteria

Description	**Filter Aid Polymer Preparation System**	**Sludge Polymer Preparation System**
Minimum Mixing Water Temperature (°C)	10	10
Polymer Specific Gravity	1.00 – 1.14	1.00 – 1.14
Polymer Concentration Range (%)	0.1 - 0.5	0.1 - 0.5
Polymer Design Concentration (%)	0.5	0.5
Minimum Polymer Dose (mg/L)	0.01	1.0
Minimum Pure Polymer Usage (kg/d)	1.0	0.1
Maximum Polymer Dose (mg/L)	0.05	5.0
Maximum Pure Polymer Usage (kg/d)	20.4	4.7
Minimum Plant Flow (ML/d)	100	0.06
Maximum Plant Flow (ML/d)	407	2.33

.4 General

.1 All components of the Polymer Preparation Systems shall be specifically designed for handling the intended chemicals and shall be constructed from appropriate corrosion and abrasion resistant material.

.2 All equipment specified in this Section and Section 11347, Polymer Feed System, Standby, shall be designed and furnished by a single polymer equipment Manufacturer who is responsible for component compatibility and suitability to the application. Installation shall be by others.

.3 Provide the following:

.1 Supply and install one (1) Filter Aid Polymer Preparation System.

.2 Supply and install one (1) Sludge Polymer Preparation System.

.4 Polymer preparation units shall be sized for a design polymer concentration of 0.5%.

.5 Each polymer preparation unit shall have tankage for mixing and storage with sufficient capacity to allow for adequate aging and storage of polymer solution. Mixing and storage tank operations to be automatic, controlled by the Polymer PLC.

.6 Supplier shall supply all a complete and functional system that shall be controlled by the Polymer PLC.

.7 Provide sufficient mixing energy to activate long chain polymers without imparting excessive shear.

.8 Provide Polymer Preparation System that operates on an automatic, sequential cycle to prepare fully active polymer solution.

.9 The dry polymer to be utilized in the system will be in the microbead or powder form. The dry polymer used can either have a cationic, anionic or non-ionic charge.

.10 Dry polymer shall be conveyed from the Dry Polymer Storage Room to the Polymer Preparation Unit utilizing Pneumatic conveyance.

.5 Wetting Unit

.1 Provide a polymer wetting unit capable of preparing long chain polymers without imparting excessive shear.

.6 Mixing/Aging Tank

.1 Provide mixing/aging tank(s) and appurtenances for mixing of the polymer solution after discharge from the wetting unit and before transfer to the feed tank.

.2 Construct the mixing/aging tank of FRP or equal, to be free standing.

.3 Mixing/Aging tank(s) must include support for mixer bridge.

.4 Provide the mixing/aging tank with a capacity adequate to meet polymer system demand.

.7 Blending Water Control

.1 Each unit shall incorporate a blending water switch (flow or pressure) to monitor blending water flow and if required shut down the polymer preparation process on low water flow.

.8 Mixer

.1 Provide a mixer for the mix tank, fixed and mounted to the tank top bridge.

.2 Mixer to be driven by a TEFC electric motor, operating on 600/3/60 power, conforming to Division 16.

.3 Ensure all wetted parts of the mixer are stainless steel.

.9 Transfer Valves and Piping

.1 Provide system to transfer solution from mix tank to feed tank. System shall operate by gravity, with automated valves, controlled by the polymer PLC.

.2 A motorized ball valve shall be provided to transfer polymer solution from the mix/age tank to the feed tank.

.3 Overflow and drain lines to be installed by Others.

.4 Include solution transfer time when sizing related equipment.

.10 Liquid Level Control Sensors

.1 Provide liquid level control sensors to detect liquid levels in the mix tank.

.2 Ensure all level devices are integrated into the PLC.

.3 Liquid level sensors shall consist of either:

.1 Ultrasonic Level Transmitter.

.2 Non-fouling conductance level probes.

.4 Provide all control components in accordance with the requirements of Division 17 and the P&ID Drawings.

.11 Motor Starters and Starter Cabinet

.1 Provide motor starters and panel to house the motor starters for the system.

.2 Provide starter panel with a NEMA 12X rated enclosure. Provide panel and panel wiring in accordance with Division 16.

2.4 Polymer Feed and Post Dilution System

.1 The Polymer Feed and Post-Dilution Systems shall be capable of storing prepared polymer solution, feeding and post-diluting the polymer solution to the filter aid and Sludge systems. Prepared polymer solution from the polymer preparation units will be conveyed by gravity to two (2) polymer solution feed tanks. The Filter Aid and Sludge polymer solution feed pump skid systems shall convey prepared polymer solution from the feed tanks to their respective process dosing points. As the polymer solution is pumped to their respective polymer dosing points it shall be post-diluted with plant service water.

.2 Capacities and Performance

.1 Design Criteria

Description	**Filter Aid Polymer Feed and Post-Dilution System**	**Sludge Polymer Feed and Post-Dilution System**
Temperature (°C)	10	10
Polymer Specific Gravity	1.00 – 1.14	1.00 – 1.14
Polymer Concentration Range (%)	0.1 - 0.5	0.1 - 0.5
Feed Tank Capacity (L)	4,000	2,500
Polymer Feed Pumps (Duty + Stand-by)	2 + 1	1 + 1
Number of Pump Feeds	1	1
Number of Pumps Per Skid	3	2
Polymer Pump Type	Progressing Cavity	Progressing Cavity
TDH (m)	35	35
Drive Type	Variable Frequency	Variable Frequency
Motor Data (V/ph/Hz)	600/3/60	600/3/60
Colour	Manufacturer Standard	Manufacturer Standard

.2 Pumping Condition

Description	**Filter Aid Polymer Feed Pumps**	**Sludge Polymer Feed Pumps**
Minimum Volumetric Feed Rate each Pump (L/hr)	4.2	0.50
Maximum Volumetric Feed Rate each Pump (L/hr)	84.8	38.8
Minimum Required Metering Pump Flow Turndown	21	78
No. of Dose Pumps Operating	2	1
Pump Operation Duration (h/d)	24	24

.3 All components of the Polymer Feed and Post-Dilution System shall be specifically designed for handling the intended chemical and shall be constructed from appropriate corrosion and abrasion resistant materials.

.4 Polymer Feed Tanks

.1 Supply and install two (2) polymer solution feed tanks and related appurtenances. Tanks shall be sized as indicated in above table

.2 Closed top fibreglass tanks shall be provided. Tank height shall not exceed 4.0 m. Each tank shall have its respective working volume below the overflow outlet pipe and above the top of the discharge pipe. Tank shall be vertical design with integral flat bottom with no bottom or sidewall seam. Tank shall include a translucent exterior protective coating with UV inhibitor. Each tank shall have an appropriate hold down lug system.

.3 Accessories

.1 Provide an ultrasonic level transducer/transmitter in each feed tank. Level transmitters shall supply a 4-20 mA level signal and a discrete fault output to the Polymer PLC.

.2 Each feed tank shall have a clear 25 mm diameter PVC liquid level sight glass calibrated in litres c/w shutoff valve and vent

.3 Each feed tank shall have two (2) 316 stainless steel lifting eyes.

.4 Each feed tank shall be supplied with manway access doors

.5 Furnish each feed tank with the size and number of connections as indicated on Drawings.

.5 Progressive Cavity Pumps

.1 General

.1 Supply and install three (3) filter aid progressive cavity feed pumps and related appurtenances.

.2 Supply and install two (2) Sludge progressive cavity feed pumps and related appurtenances.

.3 Pumps shall be as specified in Section 11315, Progressing Cavity Pumps.

.6 Polymer Pump Skids

.1 General

.1 The supplier shall fabricate pump skids and furnish equipment as shown in the P&IDs and described herein.

.2 The filter aid pump skid shall contain three (3) pumps. The Sludge pump skid shall contain two (2) pumps. Pump skids shall be sized appropriately to fit in the designated location in the Polymer Preparation and Chemical Feed Room, as shown in the included general arrangement Drawings.

.3 All components of the polymer pump skids including pump, speed controller, motor, and post-dilution unit shall be pre-plumbed and pre-wired. Skid shall be 304 stainless steel and fork truck compatible. Mounting hardware shall be 304 stainless steel.

.2 Post-Dilution System

.1 System shall include a skid-mounted post-dilution unit for each pump consisting of a static mixer in a clear PVC housing, rotameter-type flow indicator with rate-adjusting valve, pressure gauge, solenoid valve and 304 stainless steel brackets. Pump skids shall be configured as indicated on the Drawings.

.3 Accessories

.1 Provide a magnetic flow meter to measure the dilute polymer flow from each metering pump. Magnetic flow meters shall be of the wafer type, ¼-inch diameter with ceramic liner and platinum electrodes. Meters shall have IP 67 protection and CSA approval. Each meter shall be supplied with an integral mounted flow converter. Housing shall be polyurethane coated die cast aluminum with IP 66/67 rating and include a local LCD display, integrated diagnostics 4-20 mA flow output, discrete fault output and operate from a 120 VAC, 60 Hz power supply from the post-dilution skid control panel. Meters to meet Division 17 Specifications.

.2 Each pump shall be supplied with pre-piped calibration column and pressure relief valve. The calibration column shall be constructed of clear PVC and shall be complete with a vented top cap. The column shall be graduated in milliliters with a capacity of 500 ml

.3 The Installer shall supply and install the following accessories:

.1 Interconnecting piping, fittings, reducers, valves, strainers, flexible fittings, quick connect connections and related appurtenances to make a complete system. All Interconnecting piping shall be Schedule 80 PVC.

2.5 Instrumentation and Control

.1 General: Refer to Division 17 for general instrumentation and control requirements. All instrumentation, control, and electrical components provided under this Section shall comply with the requirements of Division 17.

.2 All instruments and devices indicated on the P&ID shall be provided, factory wired, and mounted. All instruments shall be of NEMA 4 construction.

2.6 Polymer preparation System Control Panel

.1 The polymer preparation system shall be furnished with a NEMA 4X control panel containing a factory mounted programmable logic controller (PLC). All controls and instruments shall fail into safe condition. Units shall not operate unless energized, nor can they operate under fault conditions.

.2 The polymer system programmable logic controller (PLC) as specified below shall start, sequence, alarm and shutdown the polymer system based on received local and remote inputs and outputs that provide automatic monitoring and control of all operating variables. The control panel will include an industrial grade PC as specified below to provide local operator monitoring and control. During normal operation, the PLC will receive flow command signals and start and stop requests from the plant control system via Ethernet.

.1 Programmable Controllers:

.1 All PLC’s shall be Modicon Unity hot standby processors complete with the redundant processors. No substitutes. They shall be supplied with Ethernet communication modules in order to enable the PLC to operate as a peer on the Ethernet plant control network.

.2 Specific requirements of the PLC outlined in Division 17.

.3 Monitor data communications between the PLC and the Plant control system by passing data bits (“heart beat” check).

.2 Operator Controls and Interfaces: Provide an industrial grade PC with the following features:

.1 Color flat screen display.

.2 Membrane keypad.

.3 NEMA 4X (indoor only).

.4 Ethernet port.

.5 Provide programming software, license, and download cable.

.6 Display screens shall be configured to have the following capabilities:

.1 Display alarms and diagnostic data.

.2 Monitor system parameters.

.3 Operate all control loops in manual and switch loops from auto to manual.

.4 Operate all equipment and auxiliaries controlled by the PLC.

.5 Adjust PLC set points. (Alarm set point changes shall require PLC programming laptop).

.6 Read the status of all digital and analog I/O.

.3 Provide separate panels for instrumentation/PLC and motor starters. A UPS supply for critical loads and a non-UPS supply for non critical loads such as a control panel convenience light and receptacle shall be supplied to the polymer system control panel by others. Power to the motor starter panel will be supplied by others.

.4 The polymer preparation unit PLC shall provide the following functions:

.1 Manual/automatic control of make-up cycles

.2 Start/stop batch cycles

.3 Mixer timer set time (seconds)

.4 Dry feeder timer set time (seconds)

.5 Dry feeder start and stop.

.6 Spout gate solenoid open and close.

.7 Vibrator start and stop

.8 Water solenoid valve open and close

.9 Mixer start and stop

.10 Transfer valve open and close

.5 Push-to-test indicating lights shall be provided on the polymer preparation unit control panel to provide the following statuses:

.1 Batching indication

.2 Transfer valve open indication

.3 Low feed tank alarm indication

.4 Feeder motor alarm indication (overload)

.5 Mixer motor alarm indication (overload)

.6 Low inlet water pressure alarm indication (shutdown)

.7 Low dry storage hopper level (shutdown)

.8 Feeder funnel alarm indication (shutdown)

.9 System alarm light/reset

.6 Additional display functions shall include run indication for each mechanical device as required for operator interface and monitoring of the polymer equipment.

.7 Operation shall be sequential batch type, continuous and fully automatic. Upon low level (falling) in the mix tank, the transfer valve is closed and the air blower is energized to blow air through the pneumatic conveying line to the wetting unit atop the mix tank. After an operator adjusted time delay water begins flowing through the wetting device atop the mix tank and the dry polymer feeder delay timer (operator adjustable) is energized. Once the dry feeder delay timer times out dry polymer is metered and travels through the pneumatic conveying line to the wetting device. Intense water sprays thoroughly wet each individual dry polymer particle. Once the lower mixer impeller is covered with water, the tank mixer is energized. The dry feeder shuts down on a timer and the feeder shut-off gate closes. Mix tanks shall be configured such that the mixer is energized before dry polymer feed is started and there is sufficient space in the tank to meter all of the polymer required for a 0.5% batch concentration. At no time shall the dry polymer feeder operate without the mixer. Water flow continues, filling the tank to the high level, at which time the high-level probe stops the water fill cycle and after a time delay de-energizes the air blower. At this point the adjustable mixer timer is started and the mixer continues mixing until it times out, signaling completion of the mix cycle. The newly mixed polymer batch continues aging until mid level (refill) is reached in the lower feed tank.

.8 When level probes in the feed tank signal refill, the mixed and aged batch is transferred via gravity to the feed tank by opening the electric actuated transfer valve. After transfer and low water level is reached in the mix tank, the transfer valve is closed and the mix/age cycle repeats.

.9 Semi-dilute 0.5 percent and aged polymer shall be continuously withdrawn from the bottom of the feed tank, with the mix tank preparing batches of newly mixed and aged polymer for recharging the feed tank.

2.7 Pump Skid Control Panels

.1 Each pump skid shall be supplied with a control enclosure housing electronic VFD's and the auxiliary control devices specified herein. The control enclosure shall be NEMA 4X. The Polymer PLC located in the polymer preparation system control panel shall start, alarm and shutdown the post dilution system and automatically monitor and control all operating variables. The enclosure front panel shall include a fusible disconnect switch, an "Computer-Off- Hand" selector, the VFD drive control interfaces, pump "Run" and "Fail" indicating lights and pump flow rate indication for each pump provided. In the "Hand" mode, the pump shall run continuously. In the "Computer" mode, the pump shall be controlled by the Polymer PLC. Speed shall be controlled locally in the "Hand" mode, and from a remote 4-20 mA input signal when in the "Computer" mode. The polymer PLC shall be provided with pump running, pump ready, and pump in "Computer" mode discrete inputs and pump speed and drive current draw analog inputs.

.2 The control enclosure shall be supplied with a 575 VAC, 3-phase, 60 Hz pump power supply and two 120 VAC, 1-phase, 60 Hz control circuit power supplies: a UPS supply for critical loads and a non-UPS supply for non-critical loads. Power will be supplied by others. The Contractor shall supply load requirements for all 2 supplies as a Shop Drawing submittal.

.3 The polymer PLC shall receive remote inputs to flow pace each polymer pump based on totalized flows from their respective processes. The Filter aid polymer pumps will be flow paced to the totalized flow through each ozone contactor train inferred from the flocculation/DAF influent flow meters. Filter Aid polymer pump 1 shall be flow paced by the Q_{total} of DAF units 1 to 4 and Filter Aid polymer pump 2 shall be flow paced by the Q_{total} of DAF units 5 to 8. The Sludge polymer pump will be flow paced to the totalized flow on the sludge discharge pipe upstream of the thickeners at the flocculation chamber

.4 The Contractor shall supply and install all wiring and conduit within a skid package. Cables between skids shall be supplied and installed by others.

2.8 Piping and Tubing

.1 Supply and install all interconnecting piping and tubing within each skid mounted assembly. Unless otherwise specified, provide valves that are the Manufacturer's standard, suitable for the intended service conditions.

.2 Run all piping in vertical and horizontal planes. Arrange piping to ensure that undue stresses from thermal expansion are not transmitted to equipment components. Do not route piping in locations or at heights that will create tripping hazards or impede the required movement of personnel.

2.9 Accessories

.1 Equipment Identification Plates: A 16-gauge stainless steel identification plate shall be securely mounted on all equipment provided under this Section in a readily visible location. Plate shall bear the 10 mm (3/8-inch) engraved and black enamel filled equipment identification number indicated in this Specification and/or as shown on Drawings.

.2 Lifting Lugs: Equipment over 50 kg (100 lbs) in weight shall be provided with lifting lugs.

.3 Anchor Bolts: Anchor bolts shall be Type 316 stainless steel and at least 12 mm (1/2 inch) in diameter. Coordinate required size with final Shop Drawings.

2.10 Finishes

.1 Factory prime all finishes in accordance with Section 11901 – Factory Applied Maintenance and Corrosion Protection Coatings.

3. EXECUTION

3.1 Contractor's Representative

.1 A Contractor's Representative is to attend the Site prior to the arrival of the equipment to train the Installation Contractor and ensure a seamless custody transfer.

.2 A Contractor's Representative shall attend the Site to witness installation and testing to ensure the equipment is installed and operated as intended.

.3 The Contractor's Representative shall verify the Installation Contractor's understanding by completing **Form 101** as shown in **Section 01650** – Equipment Installation.

3.2 Installation Training

.1 Instruct the Installer in the methods and precautions to be followed in the installation of the pump(s).

.2 The Contractor's Representative shall verify the Installation Contractor's understanding by completing **Form 101** as shown in **Section 01650** – Equipment Installation.

3.3 Testing

.1 Ensure that each piece of equipment, including all component parts, operates as intended.

.2 Cooperate with the Installation Contractor to fulfill the requirements for successful testing of the equipment, as documented by Form 103, illustrated in Section 01650 – Equipment Installation.

3.4 Commissioning

.1 Attend performance and installation testing of the process system which includes the equipment specified in this Section to ensure that each piece of equipment functions as intended in the process system.

3.5 Supply of Chemicals

.1 The City will be responsible for supplying all chemical required for the new polymer make-up equipment. Coordinate requirement for chemicals with the Contract Administrator.

END OF SECTION

1. GENERAL

1.1 References

.1 The unit shall be in compliance with the appropriate sections of the following codes:

.1 NSF International, Standard 61 - Drinking Water System Components.

.2 American Gear Manufacturers Association (AGMA).

.3 American Institute of Steel Construction (AISC).

.4 American Iron and Steel Institute (AISI).

.5 American Society of Mechanical Engineers (ASME).

.6 American National Standards Institute (ANSI).

.7 American Society for Testing and Materials (ASTM).

.8 Canadian Electrical Code (CEC).

.9 Canadian Standards Association (CSA).

.10 Electrical and Electronic Manufacturers Association of Canada (EEMAC).

.11 Electrical Safety Authority (ESA).

.12 Institute of Electrical and Electronics Engineers (IEEE).

.13 The Instrumentation, Systems and Automation Society (ISA).

.14 National Electrical Code (NEC).

.15 National Fire Protection Association (NFPA).

.16 National Electrical Manufacturers Association (NEMA).

.17 Steel Structures Painting Council (SSPC).

.18 Manitoba Building Code.

.19 Canadian Plumbing Code (CPC).

.20 Occupational Safety & Health Act (OSHA).

1.2 Contractor Submittals

.1 Shop Drawings:

.1 Make, model, and weight of each equipment assembly.

.2 Complete catalog information, descriptive literature, Specifications, and identification of materials of construction.

.3 Detailed mechanical Drawings showing the equipment location and dimensions, size and locations of connections, weights of associated equipment, and construction details.

.4 Performance Specifications of all items of equipment.

.5 Process schematics associated with all items of equipment.

.6 Instrument layout of the control panel.

.2 Submittal of Interface Material: The following materials, defining the interface between the system specified herein and the remainder of the plant, plus any additional information called for in these Specifications, shall be submitted to the Contract Administrator within ninety (90) days following execution of Contract, and prior to any construction or fabrication that requires interfacing with the system.

.1 Identification, description, and envelope dimensions for each separately installed subassembly or piece of equipment and the associated connection dimensions to permit incorporation of the system selected into the design of the plant.

.2 Information on field and installation requirements, including mounting requirements, access, and approximate total weight of each piece of equipment.

.3 A detailed description of the instrumentation and control system, including a list of all functions monitored, controlled, and/or alarmed. Describe all automatic shutdown features and interfaces with the plant instrumentation and control systems. The description of the instrumentation and control system shall be in both word and schematic form. Schematics shall be in accordance with the latest edition of NEMA ICS.

.4 Clearly identify the tag name, model numbers and catalogue numbers for each piece of equipment, component, device, etc., within the Product's technical literature. Clearly identify these model numbers using red ink on all of the Manufacturer's technical literature, such as but not limited to, instruction manuals, technical bulletins, and Manufacturer's Specification Sheets (i.e., Manufacturer's Cut Sheets).

.5 Electric motor control schematics. Include locations of control stations, and any special control to be provided by others. Coordinate polymer controls with Plant Control System.

.6 All Drawing submittals shall conform to Drawing number and tagging conventions as indicated on the P&IDs. Submittal Drawing numbers can range from WC-P0005 to WC-P0199. Use same equipment tags as indicated on P&ID on all Drawing submittals.

.7 A complete description of all interface links between the system components and between the system and other plant components. Provide a summary by interface link for the following:

.1 Number, size, and type of all process and auxiliary connections.

.2 Number, size, and type of electronic or electrical signal wires.

.3 Number, size, and type of electrical power wires.

.8 Control panel envelope dimensions, mounting requirements, and access requirements (doors, louvers, etc.).

.3 Informational Submittals:

.1 Field Performance Test Report.

.2 Special shipping, storage and protection, and handling instructions.

.3 Manufacturer's printed installation instructions.

.4 Manufacturer's Certificate of Proper Installation.

.5 Suggested spare parts list to maintain the equipment in service for a period of 1 year. Include a list of special tools required for checking, testing, parts replacement, and maintenance with current price information.

.6 List special tools, materials, and supplies furnished with equipment for use prior to and during startup and for future maintenance.

.7 Operation and Maintenance Manuals: As specified in Section 01730, Operation and Maintenance Manuals.

1.3 Preparation for Shipment

.1 Insofar as is practical, equipment specified herein shall be factory assembled and tested. Parts and assemblies that are of necessity shipped unassembled shall be packaged and tagged in a manner that will protect equipment from damage and facilitate final assembly in the field. Machined and unpainted parts shall be protected from damage by elements with application of a strippable protective coating.

1.4 Required Spare Parts and Special Tools

.1 Manufacturer's suggested spare parts shall be shipped in a wooden box and shall be protected from damage, from moisture and dirt accumulation. Parts shall be protected as for

an extended storage period. The box shall be heavily constructed with hinged cover, hasp and lock, and designed as a permanent storage enclosure for the spare parts. The spare parts shall, if possible, be enclosed within an airtight membrane. Spare parts supplied in matched sets, such as drive belts, shall be wrapped, bound, or labeled to indicate a set.

.2 Furnish one (1) year supply of lubricants including oil and greases, as recommended by the Product Manufacturer. The lubricants shall include summer and winter grades along with alternative references to equal Products of other Manufacturers including Specifications such as AGMA numbers, viscosity.

2. PRODUCTS

2.1 General

.1 The standby polymer feed system shall be a skid mounted assembly consisting of metering pump, mixing chamber, and all piping, valves, and controls required to deliver the required minimum and maximum litres per hour of polymer solution as shown herein. Included with each polymer feed system shall be a pressure relief valve, back pressure valve, and calibration chamber.

2.2 Equipment

.1 General:

.1 A back-up emulsion polymer activation and blending system shall be provided to produce and feed a 0.1 - 0.5% concentration polymer solution to any of the three (3) feed tanks.

.2 Polymer feed system shall consist of an integrated equipment package system which shall meter, dilute, activate, mix, and feed liquid polymer and water. System shall not rely upon a static mixer as the means of polymer activation. Polymer shall not be exposed to a rotating centrifugal pump turbine or other machinery that would cause excessive shear.

.3 Feed systems shall include a suitable feed pump to provide the capability of pumping emulsion type liquid polymers. At no time shall liquid polymer or polymer solution be exposed to excessive shear, so as to degrade the effectiveness of the polymer molecular chains.

.4 Polymer feed system shall be furnished with an integrally mounted control panel.

.5 Each polymer feed system shall be equipped with Type 304 stainless steel side frame and stainless steel base with nonskid feet.

.2 Capacities and Performance

.1 Design Criteria:

Description	Stand-by Emulsion Polymer Preparation System
Minimum Mixing Water Temperature (°C)	10
Polymer Specific Gravity	1.00 – 1.14
Polymer Concentration Range (%)	0.1 – 0.5
Polymer Design Concentration (%)	0.5
Minimum Polymer Dose (mg/L)	0.01
Minimum Pure Polymer Usage (kg/d)	1.0
Maximum Polymer Dose (mg/L)	0.05
Maximum Pure Polymer Usage (kg/d)	20.4
Minimum Plant Flow (ML/d)	100
Maximum Plant Flow (ML/d)	407

.3 Stand-by Emulsion Polymer Preparation System:

.1 General

.1 Supply Products modified as necessary by the Supplier to provide the specified features and to meet the specified performance for the specified operating conditions.

.2 All equipment specified in this Section and Section 11346, Polymer Feed System, Dry, shall be designed, and furnished by a single polymer equipment Supplier who is responsible for component compatibility and suitability to the application, for installation by Others.

.3 The polymer preparation/dilution system shall be an integrated equipment package capable of preparing a homogenous polymer solution. The system shall be an automatically controlled, sequentially batching unit capable of preparing liquid polymer solution from emulsion feed stock.

.4 Polymer mixing system shall be specifically designed to invert, disperse, and activate in solution emulsion polymers which may vary in specific gravity from 0.98 to 1.14 and vary in viscosity from 80 to 6,000 cpl.

.2 Blending Water Control

.1 Mixing of concentrated (neat) polymer with water shall be accomplished with an appropriate mixing method.

.2 Each unit shall incorporate a blending water switch (flow or pressure) to monitor blending water flow and if required shut down the polymer preparation process on low water flow.

.3 All valves and piping to and from the Stand-by Emulsion Polymer Preparation shall be provided by Contractor.

.3 Pump

.1 Provide one (1) polymer pump to transfer emulsion polymer from tote to Stand-by Emulsion Polymer Preparation Unit.

.2 Polymer transfer pump shall be suitable type for transferring polymer, having materials of construction selected for resistance to the pumped solution.

.4 Polymer Tote Platform

.1 Provide one (1) 3100 mm (L) x 1800 mm (W) x 1000 mm (H) polymer tote platform. Design tote platform for two (2) full polymer totes. Polymer tote platform to be constructed from carbon steel and shall be coated with appropriate corrosion and abrasion resistant surface finishes.

.2 Polymer tote platform to include load cells and summation module to weigh and transmit a 4 to 20 mA weight signal of polymer totes to the polymer system PLC. The summation module shall perform net weight and tare weight calculations. A local NEMA 4 panel shall be provided to house the summation module and include local weight display with tare adjustment.

.3 All valves and piping from totes, to Standby Polymer Preparation Unit and from Standby Polymer Preparation Unit to feed tanks unit shall be provided by Contractor.

.5 Controls

.1 Control of the Stand-by Polymer Preparation Unit shall be integrated with Dry Polymer Feed System and performed through the polymer system PLC.

.4 Approved Equipment Manufacturers

.1 Severn Trent

.2 CIBA

.3 Tomal

2.3 Control Systems

.1 General: Refer to Division 17 for general instrumentation and control requirements. Instrumentation, control, and electrical components provided under this Section shall comply with requirements of Division 17.

.2 A NEMA 4X type control panel shall be provided for the liquid Stand-by Polymer blending unit.

.3 The control panel shall include adjustable time delay relays for pre-flush, post flush. Push to test indicating lights shall be mounted on the front of the control panel for low water flow alarm and no polymer flow.

.4 Dry contacts shall be provided in the control panel for remote input of the following statuses to the polymer system PLC:

.1 System in Remote

.2 System Running

.3 Low Water Flow

2.4 Accessories

.1 Equipment Identification Plates: A 16-gauge stainless steel identification plate shall be securely mounted on the equipment in a readily visible location. Plate shall bear 1/4-inch die-stamped equipment identification name indicated in this Specification and/or as shown on Drawings.

.2 Lifting Lugs: Equipment over 100 pounds in weight shall be provided with lifting lugs.

.3 Anchor Bolts: Anchor bolts shall be Type 316 stainless steel and at least 1/2 inch in diameter. Coordinate required size with final Shop Drawings.

2.5 Finishes

.1 Factory prime all finishes in accordance with Section 11901 – Factory Applied Maintenance and Corrosion Protection Coatings.

3. EXECUTION

3.1 Contractor's Representative

.1 A Contractor's Representative is to attend the Site prior to the arrival of the equipment to train the Installation Contractor and ensure a seamless custody transfer.

.2 A Contractor's Representative shall attend the Site to witness installation and testing to ensure the equipment is installed and operated as intended.

3.2 Installation Training

.1 Instruct the Installer in the methods and precautions to be followed in the installation of the pump(s).

.2 The Contractor's Representative shall verify the Installation Contractor's understanding by completing Form 101 as shown in Section 01650 – Equipment Installation.

3.3 Testing

.1 Ensure that each piece of equipment, including all component parts, operates as intended.

.2 Cooperate with the Installation Contractor to fulfill the requirements for successful testing of the equipment, as documented by Form 103, illustrated in Section 01650 – Equipment Installation.

3.4 Commissioning

.1 Attend performance and installation testing of the process system which includes the equipment specified in this Section to ensure that each piece of equipment functions as intended in the process system.

3.5 Supply of Chemicals

.1 The City will be responsible for supplying all chemical required for the new polymer make-up equipment. Coordinate requirement for chemicals with the Contract Administrator.

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 or 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. The Contractor may submit for review alternative coating systems for specific items of equipment which provide equal or better corrosion protection and maintenance service than those specified herein.

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 micron 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 cleanness in accordance with NACE No. 3 and obtain a 50 micron blast profile.

2.2 Prime Coating

.1 Prime coat all ferrous surfaces before the blasted surfaces deteriorate.

.2 Coat ferrous surfaces with inorganic zinc primer, containing a minimum of 50% solids by volume, applied to a minimum dry film thickness of 75 microns.

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 damage to coatings occurring at any time prior to the application of any further 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

ELECTRICAL GENERAL REQUIREMENTS

1. GENERAL

1.1 Work Included

.1 Complete an operational electrical package for each Process Unit as required.

.2 Identify and submit to the Contract Administrator power requirements for each Process Unit. The Contractor shall identify the size of an over current protection device and feeder size for each Process Unit supplied, within 14 days of award of Contract.

1.2 Quality Assurances

.1 Codes, Rules, Permits, and Fees:

.1 Comply with all laws, ordinances, rules, regulations, codes, and orders of all authorities having jurisdiction relating to this Work.

.2 Comply with all rules of Canadian Electrical Code (CEC) Part I C22.1-98.

.3 Comply with all rules of local Electrical Code and the applicable building codes.

.4 Quality of Work specified shall not be reduced by the foregoing requirements.

.5 All components shall be Canadian Standards Association (CSA) approved.

.2 Standard of Workmanship:

.1 Execute all Work in a competent manner and to present an acceptable appearance when completed.

1.3 Submittals

.1 Submit samples as required where specified in Division 16 and 17.

.2 Refer to Section 01300 - Submittals for general requirements for submittals.

.3 Indicate materials, methods of construction and attachment of support wiring, diagrams, connections, recommended installation details, explanatory notes and other information necessary for completion of Work. Where equipment is connected to other equipment, indicate that such items have been coordinated, regardless of the Section under which the adjacent items will be supplied and installed.

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

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

1.4 Operation and Maintenance Manuals

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

1.5 Product Handling

.1 Use all means necessary to protect the Products of this Division until Form 100 is completed.

.2 Immediately make good any damage by repair or replacement at no additional cost to the City and to the approval of the Contract Administrator.

.3 Remove advertising labels from all electrical equipment. Do not remove identification or certification labels.

2. PRODUCTS

2.1 Selected Products and Equivalents

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

2.2 Quality of Products

.1 All Products provided shall be Underwriters Laboratories Inc. (UL) or CSA approved, or approved by local authority having jurisdiction in the area where the equipment is going to be installed.

.2 If Products specified are not approved as specified above, obtain special approval from the local regulatory authority. Pay all applicable charges levied and make all modifications required for approval.

.3 Products provided, if not specified, shall be new, of a quality best suited to the purpose required and their use subject to approval by the Contract Administrator.

2.3 Uniformity of Manufacture

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

3. EXECUTION

3.1 Equipment Identification

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

.1 Starters, contactors, and disconnects (designation, voltage, load controlled).

.2 Terminal cabinets and pull boxes (system, voltage).

END OF SECTION

SCOPE OF SUPPLY

1. GENERAL

.1 Refer to Sections 11000 through 11347.

.2 This Section describes the Electrical Division scope of supply for the Polymer Feed Equipment electrical package.

.3 The Contractor shall furnish all necessary components to provide a complete and fully functioning Polymer Feed Equipment electrical package.

.4 Contractor to provided recommendations for the supply of starters for large motors (over 22 kW).

1.2 Process Area Environment

.1 This paragraph describes process area environment for various components of the Polymer Preparation and Feed Equipment.

.1 The Polymer Feed Equipment electrical components will be installed in the water treatment plant (WTP) main process area, which is considered a wet location.

.2 Local Control Panel for the Polymer Feed Equipment and electrical distribution panels will be installed in the WTP main process area, which is considered a wet location.

1.3 Scope of Supply

.1 For all supplied equipment and skid packages the Contractor shall supply the following:

.1 All motor starters and control devices as required to supply a complete electrical system.

.2 All variable frequency drives (VFD) and control devices as required to supply a complete electrical system.

.3 All wires and cables as required to supply complete electrical system

.4 All junction boxes and pull boxes as required to supply complete electrical system.

.5 All wire and box connectors as required to supply a complete electrical system.

.6 All other components as required to supply complete electrical system.

.2 External conduit and wiring between separate equipment/skid packages is to be provided by Installation Contractor.

.3 Termination of external wiring between separate equipment/skid packages is to be provided by the Contractor.

2. PRODUCTS - NOT USED

3. EXECUTION - NOT USED

END OF SECTION

1. GENERAL

1.1 Work Included

.1 Provide a complete system of wiring, making all connections necessary for the installation of each Process Unit as required. A Process Unit is a Supplier package or individual process equipment as specified in other Sections.

.2 External conduit and wiring between separate equipment/skid packages is to be provided by others.

1.2 References, Codes, and Standards

.1 Canadian Standards Association (CSA) C22.2 No. 0.3, Test Methods for Electrical Wires and Cables.

.2 CSA Standard C22.2 No. 131 for Teck cables.

.3 Install and rate power cables in accordance with the local Electrical Code requirements.

2. PRODUCTS

2.1 Wires

.1 Conductors: stranded for ten (10) American Wire Gauge (AWG) and larger.

.2 Copper conductors: size as required by the applicable codes, with 600 V insulation of chemically cross-linked thermosetting polyethylene (XLPE) material rated RW90.

2.2 Teck Cable

.1 Conductors:

.1 Grounding conductor: copper.

.2 Circuit conductors: copper, size as required by the applicable codes.

.2 Insulation:

.1 Type: ethylene propylene (EP).

.2 Chemically XLPE rated type RW90, 600 V.

.3 Inner jacket: polyvinyl chloride (PVC) material.

.4 Armour: interlocking aluminum.

.5 Overall covering: PVC material.

.6 Fastenings:

.1 One (1) hole aluminum straps to secure surface cables 50 mm and smaller. Two (2) hole steel straps for cables larger than 50 mm.

.2 Channel type supports for two (2) or more cables.

.3 6 mm diameter threaded rods to support suspended channels.

.7 Connectors:

.1 Watertight in non classified areas, explosion-proof in classified areas, as approved for TECK cable.

2.3 Control Cables

.1 Type low voltage thermoplastic (LVT): Two (2) soft annealed copper conductors, sized as required by the applicable codes, with thermoplastic insulation, outer covering of thermoplastic jacket.

.2 Low energy 300 V control cable: Stranded annealed copper conductors sized as required by the applicable codes, with PVC insulation type over each conductor and overall covering of PVC jackets and interlocked aluminum armour.

.3 600 V type: Stranded annealed copper conductors, sizes as required by the applicable codes with PVC insulation type, XLPE type R90 (x-link) over each conductor and overall covering with sheath of aluminum interlocked armour and jacket over sheath of PVC.

3. EXECUTION

3.1 Installation of Teck Cable 0 - 1000 V

.1 Install cables.

.2 Group cables wherever possible on channels.

.3 Terminate cables in accordance with Section 16151 - Wire and Box Connectors - 0 -1000 V.

3.2 Installation of Control Cables

.1 Install control cables in conduit or use Teck cables.

.2 Ground control cable shield at one end only.

3.3 Workmanship

.1 Before pulling wire, ensure conduit is dry and clean. If moisture is present, thoroughly dry out conduits; vacuum if necessary. To facilitate pulling, recognized specially manufactured wire pulling lubricants may be used. Do not use grease. Employ suitable techniques to prevent damage to wire when ambient temperature is below the minimum permitted for each insulation type. Pull wires only into complete runs.

.2 Installation to be free of opens and grounds. Before energization, measure insulation resistance and comply with the local Electrical Code. Submit data sheet with values measured.

.3 Provide sizes of conductors as required by the applicable codes.

.4 Exercise care in stripping insulation from wire. Do not nick conductors.

3.4 Identification, Coding and Balancing

.1 Colour code all feeders at all terminations, at all points where taps are made, and at all panelboards, switchboards, motor control centres, etc. Use two (2) wraps of 3M No. 471 plastic film tape 48 mm wide.

.2 For direct current wiring use red for positive and black for negative.

3.5 Testing

.1 All power and control wiring shall be tested for insulation resistance value with a 1000 V megger. Resistance values shall be as recommended by the cable Manufacturer.

.2 All wire test results shall be properly tabulated, signed, dated, and submitted to the Contract Administrator.

END OF SECTION

JUNCTION BOXES AND PULL BOXES

1. GENERAL

1.1 Work Included

.1 Provide a complete system of splitters boxes and cabinets for the installation of wiring and equipment that is part of the equipment scope of supply.

2. PRODUCTS

2.1 Junction Boxes and Pull Boxes, Weatherproof

.1 Materials:

.1 Type 316 L stainless steel or cast aluminum, National Electrical Manufacturer's Association (NEMA) 4X suitable for outdoor locations.

2.2 Junction Boxes and Pull Boxes for corrosive process areas

.1 Materials:

.1 Stainless steel or cast aluminum, suitable for corrosive areas.

3. EXECUTION

3.1 Installation

.1 Junction Boxes and Pull Boxes:

.1 Supply all pull boxes and junction boxes required for the installation.

.2 Identify with system name and circuit designation as applicable.

.3 Size in accordance with the local Electrical Code, as a minimum.

END OF SECTION

WIRE AND BOX CONNECTORS 0-1000 V

1. GENERAL

1.1 Work Included

.1 Provide a complete system of wiring, making all connections necessary for the wiring installation on each Process Unit as required. A Process Unit is a Supplier package or individual process equipment as specified in other Sections.

1.2 Special Codes

.1 Install and rate power cables in accordance with the applicable Electrical Code requirements, or in accordance with Insulated Power Cable Engineers Association (IPCEA) requirements where permissible.

1.3 References

.1 Canadian Standards Association (CSA) C22.2 No. 65 Wire Connectors.

.2 Electrical and Electronic Manufacturers of Canada (EEMAC) 1Y-2, Bushing Stud Connectors and Aluminum Adapters (1200 Ampere Maximum Rating).

2. PRODUCTS

2.1 Materials

.1 Pressure type wire connectors: with current carrying parts same material as conductors sized to fit the conductors as required.

.2 Bushing stud connectors: to EEMAC 1Y-2 to consist of:

.1 Connector body and stud clamp for stranded copper conductors.

.2 Clamp for stranded copper conductors.

.3 Stud clamp bolts.

.4 Bolts for copper conductors.

.3 Clamps or connectors for armoured cable, aluminum sheathed cable, flexible conduit, as required.

2.2 Wire Connectors

.1 Use 3M “Scotchlock”, self-insulated connectors for hand twist wire joints for lighting, small power, and control wiring.

.2 Use T & B non-insulated ring type compression lugs for terminating No. 10 American wire gauge (AWG) and smaller motor connections. Tape with rubber and scotch tape. Lugs to accept ten (10) - 32 x 3/8" machine bolts.

.3 Terminate conductors No. 8 AWG and larger with Thomas & Betts Colour-Keyed compression connectors Series 54000, or on lugs provided with equipment.

.4 Thomas & Betts "KOPR-SHIELD" compound Series CP8 on all terminations for compression connectors.

3. EXECUTION

3.1 Installation

.1 Remove insulation carefully from ends of conductors and:

.1 Apply coat of zinc joint compound on aluminum conductors prior to installation of connectors.

.2 Install mechanical pressure type connectors and tighten screws with appropriate compression tool recommended by the Manufacturer. Installation shall meet secureness tests in accordance with CSA C22.2 No. 65.

.3 Install fixture type connectors and tighten. Replace insulating cap.

.4 Install bushing stud connectors in accordance with EEMAC 1Y-2.

3.2 Wire Connectors

.1 Select hand twist connectors for wire size and Install tightly on conductors.

.2 Brush "KOPR-SHIELD" compound on terminations for compression connectors as recommended by the Manufacturer.

.3 Install compression connectors using methods and tools recommended by the Manufacturer.

.4 Do not Install stranded conductors under screw terminals unless compression lugs are installed.

END OF SECTION

MOTOR STARTERS TO 600 V

1. GENERAL

1.1 Scope of Work

.1 This Specification describes the requirements for the supply of motor starters for three (3) phase, squirrel cage induction motors as required by various process equipment specified in this Specification.

1.2 References

.1 National Electrical Manufacturer's Association (NEMA) Contactors and Motor-starters.

1.3 Starter Requirements

.1 Provide motor starters for all single-phase and three (3) phase motors as required.

.2 Provide interlocking between starters where required.

.3 All starter accessories such as pilot lights, Computer-Off-Hand (COH), Start-Stop, etc. whether integrally or remote mounted shall be heavy duty oil tight, unless otherwise specified. Each COH switch shall have a voltage free contact terminated in terminals indicating Computer and NON-Computer position of the switch. Computer status for each COH switch shall be wired to a digital input on the programmable logic controller (PLC).

1.4 Shop Drawings and Product Data

.1 Submit Shop Drawings in accordance with Section 16010 - Electrical General Requirements and Section 01300 - Submittals.

.2 Indicate:

.1 Mounting method and dimensions.

.2 Starter size and type.

.3 Layout of identified internal and front panel components.

.4 Enclosure types.

.5 Wiring diagram for each type of starter.

.6 Interconnection diagrams.

1.5 Operation and Maintenance Data

.1 Provide operation and maintenance (O&M) data for motor starters for incorporation into manual specified in Section 16010 - Electrical General Requirements and Section 01730 – Operation and Maintenance Manuals**.**

.2 Include operation and maintenance data for each type and style of starter.

1.6 Maintenance Materials

.1 Provide maintenance materials in accordance with Manufacturer recommendation. Include maintenance materials, special tools, and spare parts.

.2 Provide listed spare parts for each different size and type of starter:

.1 Three (3) contacts, stationary.

.2 Three (3) contacts, movable.

.3 One (1) contact, auxiliary.

.4 One (1) control transformer(s).

.5 One (1) operating coil.

.6 Two (2) fuses.

.7 10% indicating lamp bulbs used.

2. PRODUCTS

2.1 Materials

.1 Starters to NEMA Standards.

2.2 Enclosure

.1 All individually mounted motor starters shall be enclosed in a general purpose sheet steel enclosure unless in wet areas where they shall be watertight Electrical and Electronic Manufacturers of Canada (EEMAC) 4.

2.3 Manual Motor Starters

.1 Manual motor starters shall be of size, type, rating, and enclosure type as required by local applicable codes, with components as follows:

.1 Switching mechanism, quick make and break.

.2 Overload heaters, manual reset, and trip indicating handle.

.3 Rated volts and poles to suit application.

.2 Accessories:

.1 Indicating lights: Heavy duty L.E.D. type and colour as indicated.

.2 Locking tab to permit padlocking in "ON" or "OFF" position.

2.4 Full Voltage Non Reversing (FVNR) Magnetic Starters

.1 Combination magnetic starters shall be of size, type, rating, and enclosure type as required by local applicable codes with components as follows:

.1 Contactor solenoid operated rapid action type.

.2 Motor overload protective device in each phase, manually reset from outside enclosure.

.3 Wiring and schematic diagram inside starter enclosure in visible location.

.4 Identify each wire and terminal for external connections, within starter, with permanent number marking identical to diagram.

.2 Combination type starters shall include fused disconnect switch, or motor circuit interrupter, or circuit breaker with operating lever on outside of enclosure to control the disconnect switch, or the motor circuit interrupter or the circuit breaker, and provision for:

.1 Locking in "OFF" position with up to three (3) padlocks.

.2 Independent locking of enclosure door.

.3 Provision for preventing switching to "ON" position while enclosure door open.

.3 Accessories:

.1 Pushbuttons, selector switches: heavy duty labelled to identify control function.

.2 Indicating lights: Heavy duty L.E.D. type red pilot light to indicate energized motor circuit and where called for, green pilot light to indicate de-energized motor circuit. Pilot lights to be push-to-test transformer type.

.3 In addition to standard, one (1)-N/O and one (1)-N/C spare auxiliary contacts unless otherwise indicated.

2.5 Full Voltage Reversing (FVR) Magnetic Starters

.1 FVR magnetic starters shall be of size, type, rating, and enclosure type as required by local applicable codes with components as follows:

.1 Two (2) to three (3) pole magnetic contactors mounted on common base.

.2 Mechanical and electrical interlocks to prevent both contactors from operating at same time.

.3 Three (3) overload relays with heater elements, manual reset.

.2 Accessories:

.1 Pushbuttons selector switches: Heavy duty labelled to identify control function.

.2 Indicating lights: Heavy duty L.E.D. type, red pilot light to indicate energized motor circuit and where called for, green pilot light to indicate de-energized motor circuit. Pilot lights to be push-to-test transformer type.

.3 In addition to standard, one (1)-N/O and one (1)-N/C spare auxiliary contacts per contactor unless otherwise indicated.

2.6 Equipment Identification

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

.2 Manual starter designation label, white plate, black letters, size one (1).

.3 Magnetic starter designation label, white plate, black letters.

2.7 Approved Manufacturers

.1 Approved motor starter Manufacturers are: Schneider Electric, Cutler-Hammer, Square D, and Allen Bradley.

.2 Multilin motor protector relays are preferred for large motor protection.

3. EXECUTION

3.1 Installation

.1 Install starters.

.2 Ensure correct fuses and overload devices elements installed.

3.2 Starter Verification

.1 Field check motor starters supplied by Installation Contractor prior to commissioning equipment. As a minimum, verify the following:

.1 Check of control circuits.

.2 Verify that overload relay installed is correctly sized for motor used.

.3 Record overload relay size and motor nameplate amperage.

.4 Visual inspection of fuses and contactors.

.5 Ensure all connections are tight.

.2 Measure and record motor amps under load conditions and compare with full load amps and motor service factor. Report any excessive readings and unbalance. Measure voltage as close to motor terminals as possible while motor is running.

.3 Set all motor circuit protectors to the minimum level which will consistently allow the motor to start under normal starting conditions.

3.3 Overload Relays

.1 For starters provided, select overload relays in accordance with relay and motor Manufacturers' recommendations, considering motor service factors, ambient temperature, temperature differences between motor and starter locations. Monitor motor operation during start-up to ensure motor operation is satisfactory and relays provide proper protection. For side inlet fans and other long acceleration time loads, provide special overload relays to suit the start-up condition. Provide Manufacturers' curves and data sheets for the driven equipment where necessary to provide supporting data for motor protection.

3.4 Field Quality Control

.1 Operate switches, contactors to verify correct function.

.2 Perform starting and stopping sequences of contactors and relays.

.3 Check that sequence controls, interlocking with other separate related starters, equipment, and control devices operate as indicated.

END OF SECTION

VARIABLE FREQUENCY DRIVES

1. GENERAL

1.1 Standards

.1 All variable frequency drives (VFD's) 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 Initial setup and programming will be provided by Installation Contractor in accordance with Section 01650.

.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 Initial setup and programming will be provided by the Installation Contractor in accordance with Section 01650.

.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.

.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 one of the following acceptable Manufacturers:

.1 ABB.

.2 Mitsubishi.

.3 Toshiba.

.2 Variable speed controller shall be electronic adjustable frequency and voltage output unit.

.3 The VFD shall employ a minimum 6-pulse PWM (pulse width modulated) inverter system utilizing Insulated Gate Bipolar Transistors (IGBT) power switching devices and come complete with line reactors or DC link filters.

.4 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.

.5 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.

.6 Input voltage shall be as indicated on motor schedules and Drawings (line voltage variation ±10%). Based on 347/600 volt systems (Not 575 V). Line frequency variation ±5%. Output voltage shall vary with motor speed to nominal motor voltage. Speed stability shall be ±1%. Drive shall match torque characteristic of load.

.7 Input frequency setting signal will be 4 to 20 mA. Output speed monitoring signal shall be 4 to 20 mA.

.8 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.

.9 Protective devices to be incorporated are:

.1 Fast acting electronic circuit board protective devices for protection of electronic components.

.2 Line reactor, DC link or filter in the drive input to protect electronic components from transient voltage conditions.

.3 Integral electronic motor overload protection adjustable up to 150% of motor rating for 60 seconds.

.4 Overcurrent instantaneous trip 250%.

.5 Programmable short-circuit protection.

.6 Programmable ground fault protection.

.7 Overvoltage/overcurrent DC bus monitor/protection.

.8 Undervoltage protection.

.9 Loss of phase and phase unbalance protection.

.10 Inverter over-temperature protection.

.11 Capable of running without motor for start-up.

.12 Output filter package (as required) to limit motor voltage to 1200 volts maximum at motor terminals. A reflective wave trap mounted at the motor may be used to accomplish this.

.13 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.

.14 Maximum acceptable noise level is 80dBA at 1m.

.10 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. Remote keypads, completely duplicating functions of integral keypads, shall also be provided for all VFD(s) located inside a fan plenum. The remote keypads in these cases shall be located adjacent to the door entering the plenum.

.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.

.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 4-20 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/transmission control protocol (TCP).

.11 Environmental Capabilities: The drive shall operate without mechanical or electrical damage under any combination of conditions as follows:

.1 Ambient temperature 10° to 40°C.

.2 Humidity 0 to 90% (non condensing).

.3 Vibration up to 0.5 g.

.4 Altitude: Plant elevation is 232 ± 50 m above mean sea level (MSL).

.12 Diagnostic and indicating features:

.1 Power On indication.

.2 Percentage speed indicator.

.3 Overload indication.

.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.

.13 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.

.14 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 transients of up to 3,000 volts with energy levels of 50 joules.

.2 Line surges of up to 115% of rated voltage for up to ten (10) cycles. Based on 347/600 volt systems.

.3 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.

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 (hp).

.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.

.2 Contractor shall make provisions for the wiring of all interlocks including (but not limited to) vibration switch, freeze stats, and fire alarms 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 variable speed drive 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.

.4 Software

.1 Provide VFD programming/troubleshooting software to City.

.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 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 O&M Manual, Electrical Section. This manual shall be issued in both Hard Copy and Electronic format.

END OF SECTION

CONTROL DEVICES

1. GENERAL

1.1 Work Included

.1 Control equipment such as:

.1 Pushbutton stations, indicating lights, control and relay panels, are supplied under this Specification to form complete control system for a Process Unit in conjunction with:

.2 Motor control centre, starters, and items provided under Section 17 for example, pressure, flow, float, solenoid valves, panels, pneumatic electric switches, transducers, etc. Some or all of the preceding items are interconnected under this Specification.

2. PRODUCTS

2.1 AC Control Relays

.1 Convertible contact type: contacts field convertible from normally-open (NO) to normally-closed (NC), electrically held with sliding barrier to permit access to contacts only or coil only, three (3) to four (4) poles. Coil rating: 120 V. Contact rating: 120 V, minimum 3 A.

.2 Sealed contact type: electrically held with three (3) to four (4) poles and front mounted contact block. Coil rating: 120 V. Contact rating: 120 V, min 3 A.

.3 Universal pole type: electrically held with three (3) to four (4) poles, convertible from NO to NC by changing wiring connections. Coil rating: 120 V. Contact rating: 120 V, minimum 3 A.

.4 Fixed contact type: heavy duty with three (3) to four (4) poles. Coil rating: 120 V. Contact rating: 120 V, minimum 3 A.

2.2 Relay Accessories

.1 Standard contact cartridges: NO - convertible to NC in field.

2.3 Sealed Contact Oil tight Limit Switches

.1 Lever type switches: roller operated, double pole, double throw. Contact rating: Electrical and Electronic Manufacturer's Association of Canada (EEMAC) B-600.

.2 Push type switches: actuated by rod located on tip or side of operating head, spring return double pole, double throw. Contact rating: EEMAC B-600.

.3 Wobble stick cat whisker type switches: actuated by rod or stick extending from tip of operating head. Moving rod in any direction operates contacts. Double pole, double throw. Contact rating: EEMAC B-600.

.4 Lever operated: time delay switch: adjustable time delay from $^1/_2$ s to 15 s plus 25%. Contact rating: EEMAC B-600.

.5 Plug-in construction switches: Canadian Standards Association (CSA) Type four (4), lever or push type, contact rating: EEMAC A-600.

2.4 Solid State Timing Relays

.1 Construction: ac operated electronic timing relay with solid-state timing circuit to operate output contact. Timing circuit and output contact completely encapsulated to protect against vibration, humidity and atmospheric contaminants.

.2 Operation: on-delay or off-delay.

.3 Potentiometer: self contained to provide time interval adjustment.

.4 Supply voltage: 120 V, ac, 60 Hz.

.5 Temperature range: minus 20°C to plus 60°C.

.6 Output contact rating: maximum voltage 300 V ac or dc. Current: EEMAC B300.

.7 Timing ranges: As required.

2.5 Instantaneous Trip Current Relays

.1 Enclosure: CSA Type 1.

.2 Contacts: NO, NC automatic reset with adjustable tripping point.

.3 Control: Three (3) wire, with provision for shorting contacts during accelerating period of motor.

.4 Contact rating: EEMAC B600.

2.6 Operator Control Stations

.1 Enclosure: CSA Type one (1), surface mounting

2.7 Pushbuttons

.1 Heavy duty, Operator recessed, flush, or mushroom type, as required. Black, with one (1)-NO and one (1)-NC contacts rated as required. Stop pushbuttons coloured red, provision for padlocking in depressed position. Design standard Allen Bradley 800 H series.

2.8 Selector Switches

.1 Maintained or Spring return to center position, as required, heavy duty, operators standard wing lever, contact arrangement as required, rated 120 V, minimum 3 A, ac. Design standard

Allen Bradley 800 H series.

2.9 Indicating Lights

.1 Heavy duty, full voltage, push-to-test, lens colour: as required, L.E.D. type lamps, labels as required. Design standard Allen Bradley 800 H series.

3. EXECUTION

3.1 Installation

.1 Install pushbutton stations, control and relay panels, control devices and interconnect.

END OF SECTION

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.

.6 Instrument cables and associated conduit and/or fasteners where the instrument is connected to a control panel or other instrument located within the same equipment package skid.

.7 Instrumentation power supplies.

.3 Ensure the correct functionality of any equipment supplied under other Divisions of this Specification.

.4 Documentation provided by the Contractor shall include as a minimum:

.1 Equipment descriptive data.

.2 Equipment installation instructions, service manuals, operation and maintenance (O&M) manuals, bills of materials, and recommended spare parts lists.

.3 Schematics and interconnection wiring diagrams sealed by a Professional Engineer registered in the Province of Manitoba.

.4 Records of conductor identification, field terminals, cable lists and all other information necessary for the installation of the equipment.

.5 I&C panel Shop Drawings, face layouts, schematics, and point-to-point wiring diagrams sealed by a Professional Engineer registered in the Province of Manitoba.

.6 For the programmable logic controller (PLC) based control system, the Contractor shall provide detailed documentation of the system hardware and software. Minimum software documentation shall include a detailed operating description, flow charts that

describe the functionality of the PLC program, a memory map, and the PLC program and documentation. This information shall be submitted at the Shop Drawing stage.

.5 Documentation provided by the Contractor shall be formatted as follows:

.1 *Piping and Instrumentation Diagrams (P&IDs)* – 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 *Input/Output Index* – A sorted index of the control system I/O points shown on the P&IDs, giving the supporting documentation as per the instrument index.

.4 *Instrument Specification Sheets* – Detail the relevant data for the supply of devices.

.5 *Instrument Loop Diagram (ILD)* – Shows typical interconnections and hook-up of devices. The Contractor is to produce an ILD for each device and record all relevant information on each sheet for submission at the completion of the Work. Fill in all terminal and wiring numbers etc. from the Shop Drawing as they become available. A set of 'B' size (11" x 17") ACAD Drawings and associated files will be made available to the successful bidder. Where an ILD is not shown for wiring of simple devices provide a legible sketch for as-built information.

.6 *Location Drawings* – Indicate in plan and/or elevation views where the instrument elements are physically located. These Drawings are provided to assist the Installer in estimating the amount of cable and ducting required.

.7 *Standard Details* – Provide a reference for installation, operation, and other instructions pertinent to a particular device.

.8 *Detailed Specification* – Lists qualifications, quality of materials and workmanship, and supplementary information.

.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.

Reference	Title
API RP550-86	Manual on Installation of Refinery Instruments and Control Systems, Part I – Process Instrumentation and Control Section one (1) Through thirteen (13)
ASME Section VII-89	Rules for Construction of Pressure Vessels
ASTM B68-86	Seamless Copper Tube

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 RP12.6-87	Installation of Intrinsically Safe Systems for Hazardous (Classified) Locations
ISA S5.4-76	Instrument Loop Diagrams
ISA S18.1-79	Annunciator Sequences and Specifications
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 1012-89	Power Supplies
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

.7 Related Work

.1 Process: Division 11

.2 Electrical: Division 16

.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 defined in the general conditions of this Specification.

.2 Install Products in accordance with the recommendations and ratings of the Product Manufacturers.

.3 Supply and execute installation of all instrumentation control tubing in accordance with Division 17.

.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.

1.2 Equipment

.1 Perform a final examination prior to delivery to Site to ensure that:

.1 All I&C components supplied for this project under this Section of the Specification comply with the requirements stated in the instrument Specification sheets.

.2 All I&C components supplied under other Sections of this Specification, to be connected to I&C components supplied under this Section of the Specification, comply with the requirements stated in the Contract documents.

.3 All I&C components conform to the specifications. Any delays in construction resulting from the delivery to Site of non-conforming I&C components shall be borne by the Contractor.

.4 Ensure that covers where required are properly installed on all equipment. Provide all covers, padding, guards, etc. as required to guard any equipment against damage.

.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 Site

.1 Process Area Environment

.1 The Polymer feed equipment area is considered to be a dusty and wet location.

1.4 Documentation

.1 Submittals

.1 Submit Shop Drawings for all Products supplied by this Division. Submit Shop Drawings for review prior to purchase of any Products or equipment and sufficiently in advance to allow ample time for checking.

.2 Contractor to review, modify, and approve the Shop Drawings prior to submitting Shop Drawings to the Contract Administrator for review. Contractor approval of a 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.

.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.

.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 Refer to Division 16 for general identification requirements. 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.

.4 Clearly mark all panels, pull boxes, junction boxes, etc. to indicate the nature of service.

.5 Provide neatly typed circuit directories for panel power distribution systems to indicate loops or devices powered by the circuit and the fuse size.

.6 For direct current wiring use black for positive and white for negative.

.7 For thermistor wiring to motors use red and blue coloured insulated wire.

3. EXECUTION

3.1 Coordination With Other Divisions

.1 Examine the 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:

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 CE Code.	150 mm	300 mm	300 mm	300 mm
Noisy	150 mm	Thermal grouping as per CE Code.	150 mm	150 mm	150 mm
Indifferent	300 mm	150 mm	Separation of circuit types.	100 mm	100 mm
Sensitive	300 mm	150 mm	100 mm	Touching	50 mm
Very Sensitive	300 mm	150 mm	100 mm	50 mm	Touching

3.4 Wire and Cable

.1 Refer to Section 17124 – Instrumentation Cable.

3.5 Equipment Connections

.1 Prior to the connection of signal wiring to process control and instrumentation devices, check the device voltage rating and polarity for compatibility with the corresponding loop

and/or schematic diagram. Where device and circuit characteristics are found to be incompatible, the connections are not to be made. Report the condition immediately to the Contract Administrator.

.2 All control wiring diagrams illustrate typical control circuits applicable to the type of equipment specified. Control circuits may vary with different Manufacturers of equipment. Verify all control circuits with the Manufacturers of the equipment and make any corrections to the control wiring diagrams that may be required.

.3 Provide power disconnect terminals in marshalling panels for all devices and PLC inputs/outputs sourced from the panel. Provide local power disconnect switches for all 120VAC power instruments. Mount adjacent the instrument.

3.6 Access Panels

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

3.7 Tagging Standards for Devices and Wiring

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

3.8 Testing of Instrumentation Loops

.1 After all devices within a loop have been connected, check the loop for correct functioning and interaction with other loops, where applicable. Provide written notice to the Contract Administrator when the loops are going to be tested so that the tests may be witnessed at the Contract Administrator's discretion.

.2 Check the operation of final control elements such as solenoid valves, actuators, etc. by manual control before checking with automatic control.

.3 Check and simulate all alarms and shutdown functions.

.4 Verify the status of all points connected or accessible to the plant control and monitoring system.

.5 Where applicable, test all tubing for leaks in compliance with ISA RP7.1. Isolate all instruments when tubing is being tested to protect against over pressure.

.6 Perform tests and record results on the test data forms that are included in this Section. Develop additional and/or more detailed test forms as necessary to suit more complex instrumentation.

.7 Sign and date all test reports. Submit the test reports to the Contract Administrator within five (5) working days of testing.

3.9 Calibration

.1 Instruments to be factory pre-calibrated. Provide a printed record of the factory calibration parameters for "smart" devices.

.2 Prior to calibration, completely program all "smart" transmitters including entries of the appropriate range and tag number. Provide a printed record of smart device serial numbers against their assigned tag number.

.3 Instruments to be set up and calibrated by an accredited instrument technician working under the approval of the instrument Manufacturer.

.4 Calibrate all instruments to an accuracy of ½ of 1% of full range, or to the Manufacturer's state accuracy of the instrument whenever an accuracy of ½ of 1% is not achievable.

.5 For each instrument supplied as part of an equipment skid, perform the following applicable calibration prior to instrument installation:

.1 Calibrate all inline flow meters by a draw-down test.

.2 Calibrate all density meters by lab samples.

.3 Calibrate all vacuum and pressure instruments by manometer or accurate test instrument and hand test pump.

.4 Calibrate gas detectors using standard gas sample.

.5 Calibrate temperature instruments against a standard lab thermometer.

3.10 Test Forms

Form No.	Title
.1 ITR	Instrument Test Report.
.2 LCR	Loop Check Report.

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: _____

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: _____

3.11 Installation and Performance Testing

.1 Refer to the requirements of Division 1 for additional requirements.

.2 Commissioning of the I&C system to include but not be limited to the following:

.1 Verify installation of components, wiring connections, and piping connections.

.2 Verify instrument calibration and provide written report.

.3 Assist I&C equipment installation Contractor's service personnel as required for complete system testing.

.4 Instruct plant personnel in correct method of operation of I&C equipment.

.5 Direct plant personnel at hand-over as to final adjustment of the system for correct operation of plant.

.6 Coordinate and cooperate with City staff and the Contract Administrator to commission the interface between the Plant supervisory control and data acquisition (SCADA) and the packaged PLC based control system.

3.12 Training

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

.2 For the PLC based control system, the Contractor shall provide maintenance training that includes a review of the PLC program, system troubleshooting, and identification of programmed system variables such as set-points, alarms, and statuses.

END OF SECTION

ENCLOSURES

1. GENERAL

1.1. References - General

.1 Equipment, Products and Execution must meet all requirements detailed in Section 17010.

2. PRODUCTS

2.1. General

.1 Unless otherwise specified, provide outside finishes on all enclosures in American National Standards Institute (ANSI) 61 Grey as specified in Division 11.

.2 The enclosures must be suitable for carrying the weight of the equipment mounted inside the panel and on the doors without any warpage.

2.2. Enclosures

.1 Provide Electrical & Electronic Manufacturer's Association of Canada (EEMAC) type 12 gasketted enclosures in MCC rooms and control rooms.

.2 All enclosures for mounting outside of motor control centre (MCC) rooms and control rooms to be EEMAC Type 4, watertight except where otherwise specified.

.3 Provide EEMAC 7/3R enclosures for equipment in and around classified areas such as sumps.

.4 Enclosures for certain equipment in corrosive atmospheres to be EEMAC 4X approved for the classification (e.g. chemical cleaning).

.5 Enclosures for mounting field control indicator lamps and switches in unclassified areas to be Allen Bradley model 800T-xTZ die cast enclosures.

.6 Enclosures for mounting field control indicator lamps and switches in Class 1 areas to be Allen Bradley model 800H-xHHX7 cast aluminum enclosures.

2.3. Panel Enclosures

.1 Fabricate panel enclosures from 11 gauge steel panels complete with necessary stiffening to form a rigid free-standing lineup. The structures must be suitable for carrying the weight of the equipment mounted inside the panel and on the doors. Provide removable top and bottom cable entry plates.

.2 Provide panels with front access only. Doors shall be key lockable and fitted with 3-point heavy duty latching assemblies. Provide a continuous piano hinge and a pneumatic hold open device on each door.

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

2.4. Marshaling and Control Panels

.1 Supply, fabricate, checkout, layout, document and deliver to Site fully equipped and functional panels.

.2 Supply all components contained on or within the panels fully wired under this Section of the Specification.

.3 The selection of all accessories, materials and methods for fabrication not covered by this Specification, but which are necessary to complete the fabrication of the control panels, is the responsibility of the Contractor.

.4 Fans and filters shall be installed to pressurize all control panels thus discouraging dust accumulation and providing air purging for temperature and corrosion control.

2.5. Wiring and Accessories

.1 Provide wiring inside the panels according to the following Specifications:

.1 Control wiring to be a minimum of #16 AWG tinned stranded copper; insulation rated at 600 V.

.2 Wiring for power distribution shall be a minimum of #14 AWG tinned stranded copper; insulation rated at 600 V.

.3 Refer to Division 16 for cable routing requirements.

.2 Tag each wire at both ends with a heat shrink sleeve that is machine printed. Allow approximately 20 mm of wire insulation between the tag and the bare wire.

.3 Wiring systems with different voltage levels or types shall be suitably segregated within the panel, according to relevant electrical codes.

.4 Run all wiring in enclosed plastic wire ways such as Panduit. Size all wire ways so that the total cross sectional area of the insulated wire and cable does not exceed 40% of the cross sectional area of the wire way.

.5 Provide a minimum clearance of 50 mm between wire ways and any point of wire termination.

.6 Terminate all wiring, incoming and outgoing, at terminal strips mounted inside the panels. Identify each terminal strip with a terminal strip number, defined as follows:

.1 Wire identification to use the connected field device tag name with the wire's corresponding end device terminal number appended to it.

.2 Identify every joint and/or terminal of the above wire run with the same identifier.

.3 For example, pressure transmitter PT-O100A located in the field has a 2 PR-TPSH cable connected to it. The cable runs through a junction box to a marshaling panel. The wire identifiers for the pair of wires would be PT-O100A all the way to the marshaling panel.

.4 Identify spare wires by using the cable tag, terminal number and an "-SP" suffix.

.5 Arrange wiring on terminal blocks such that all internal panel wiring terminates on the inboard side of the terminal blocks and all external wiring terminates on the outboard side.

.7 Two sources of 120 VAC power will be supplied by others to each control panel: UPS power for critical loads and non-UPS power for non-critical loads. Provide separate critical and non-critical 120 VAC power distribution systems and a 24 VDC power distribution system in each panel. Provide a thermal magnetic circuit breaker on each main power circuit and a fused terminal block for each branched circuit off the main.

.8 Provide disconnect type terminal blocks Weidmuller WTR 4 series to isolate field wiring that is powered sourced from the panel.

.9 Provide sufficient terminals so that not more that 2 wires are connected under the same terminal. Provide 20% spare terminal capacity at each terminal block assembly.

.10 Terminals shall be Weidmuller W Series color coded as follows:

.1	Red	=	positive 24Vdc
.2	Black	=	0Vdc common and analog signal plus
.3	White	=	analog signal common and VAC neutral
.4	Grey	=	120 VAC
.5	Green	=	ground
.6	Yellow	=	shield

.11 Provide nameplates for each device on or within the panels and enclosures. Nameplates shall be white lamacoid with black lettering, a minimum of 25 mm 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 back panels and doors. Attach a separate bonding conductor to all devices that are not firmly fastened to the panels with screws for such devices as case mounted instruments, meters, etc.

3. EXECUTION

3.1. References - General

.1 Refer to Section 17010, Part 3.

3.2. Mounting Heights

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

END OF SECTION

INSTRUMENTATION CABLE

1. GENERAL

1.1. Product Data

.1 Submit Product data in accordance with Division 1 and Division 16.

.2 Instrument cables shall be supplied and installed between all instruments and control panels that are located within a single packaged skid. Instrument cables between instruments and control panels that are not located within the same skid will be supplied and installed by others.

1.2. Related Work

.1 Refer to Division 16.

1.3. Standards

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

2. PRODUCTS

2.1. Twisted Pair Shielded Cables (TPSH)

.1 TPSH shall be constructed as follows:

.1 Two (2) copper conductors, stranded, minimum #18 AWG, PVC insulated, twisted in nominal intervals of 50 mm.

.2 Insulated for 600V, 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 compliant with 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, and continuous number coded. The cable assembly shall have an overall shield and overall flame retardant PVC jacket.

2.2. RTD and Multi Conductor Shielded Cable

.1 RTD cables shall be CSA approved and shall be constructed as follows:

.1 Three (3) or more copper conductors, stranded, minimum #18 AWG.

.2 PVC insulated for 600V.

.3 100% coverage aluminum foil or tape shield.

.4 Separate bare stranded copper drain wire.

.5 Overall flame retardant PVC jacket to CAS-C22.2

2.3. Teck Cables

.1 As per Division 16.

2.4. Wire

.1 As per Division 16.

3. EXECUTION

3.1. Analog Signals

.1 Use TPSH cable for all low level analog signals such as 4-20 mA, pulse type circuits 24 VDC and under, and other signals of a similar nature.

.2 Use RTD cable for connections between RTDs and transmitters or PLC RTD inputs.

3.2. Digital Signals

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

3.3. Instrument Power

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

3.4. Installation

.1 Install instrumentation cables in conduit systems or in cable trays. Use a minimum of 300 mm length of liquid tight flexible conduit to connect the field sensors to the conduit.

.2 Where non-armored instrumentation cables are installed in cable trays, provide barriers in the tray to separate instrumentation cables from power cables.

.3 At each end of the run leave sufficient cable length for termination.

.4 Do not make splices in any of the instrumentation cable runs.

.5 Cable shields shall be terminated on insulated terminals and carried through to the extent of the cable.

.6 Ground cable shields at one end only. Unless otherwise specified, ground the shields at the marshalling panel.

.7 Protect all conductors against moisture during and after installation.

3.5. Conductor Terminations

.1 All equipment supplied shall be equipped with terminal blocks to accept conductor connections.

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

3.6. Testing

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

3.7. Identification

.1 Identify all instrumentation cables.

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

END OF SECTION

POWER SUPPLIES

1. GENERAL

1.1 References - General

.1 Refer to Section 17010.

2. PRODUCTS

2.1 Power Supply and Conditioning Equipment

.1 General

.1 Provide all DC power supplies as required for all instrument circuits. All circuits are to be powered from the marshalling panels. Power supplies to be equal to Hammond, G.F.C. or approved equal, complete with an over-voltage protection module.

.2 Provide redundant configurations for power supply equipment serving more than one instrument loop, so that failure of a single unit will not disable all or any shared part of the instrumentation and communication system. Provide diode isolation for redundant direct current supply units, and ground the negative terminal of the power supply.

.3 Power supplies and transmitters feeding circuits that run in non-armored cable in cable tray shall meet the requirements for Class 2 circuits as defined under Section 16 of the CEC Part I.

.4 Unless otherwise required, all DC power supplies to be rated 28VDC, adjustable plus or minus 5 percent, and set to provide 26.4 volts on the panel direct current bus. Size the power supply for two times the connected load, minimum size is 2 amps.

2.2 Noise Suppression

.1 Provide power conditioners in each panel to power AC instrumentation and control loads. Power conditioners are Oneac Series CX.

2.3 UPS Power Supply

.1 Two sources of 120 VAC power will be supplied by others to each control panel: UPS power for critical loads and non-UPS power for non-critical loads.

.2 Control and operator interface system hardware including but not limited to PLC’s, PLC I/O racks, PLC communication modules, Human Machine Interface (HMI) computers and industrial network switches shall be powered from the UPS.

.3 Instrument power and associated DC power supplies shall be powered from the UPS.

.4 Non-critical loads include control panel interior lights and receptacles.

.5 Provide the total expected critical and non-critical loads fed from each control panel as a Shop Drawing submittal so that the external power sources and UPS can be properly sized.

.6 Mount a lamacoid on the control panel stating that the panel has more than one power source.

3. EXECUTION

3.1 References - General

.1 Refer to Section 17010, Part 3.

END OF SECTION

INSTRUMENT AIR SUPPLY AND TRANSMISSION

1. GENERAL

1.1 References - General

.1 Equipment, Products and Execution must meet all requirements detailed in Section 17010.

2. PRODUCTS

2.1 Pneumatic and Process Connections

.1 Pipe, fittings, valves, tubing, tube fittings, etc. required under this section of the Contract to be Swagelok or approved equal and rated for the service in which they are to be employed. Tubing and fittings are to be made of stainless steel.

.2 Dimensions:

.1 Process connections 12 mm (nominal) O.D. tubing

.2 Output/signal - 10 mm (nominal) O.D. tubing

.3 Air supply 12 mm pipe (nominal) to isolation valves and 10 mm O.D. tubing (nominal) from isolation valves to end devices (e.g. valves).

.3 Provide a continuous support channel or raceway for all tubing.

2.2 Air Sets

.1 Provide all pneumatic actuator assemblies with an air set.

.2 Provide Fischer 67FR air sets unless specified otherwise in the Instrument Specification Sheets of Section 17701.

.3 Air set to be complete with filter regulator and output gauge.

2.3 Solenoid Valves

.1 Provide ASCO Redhat type solenoid valves unless specified otherwise in Division 11 or on the Instrument Specification Sheets of Section 17701.

.2 Solenoid enclosures to be minimum Electrical & Electronic Manufacturer's Association of Canada (EEMAC) 4; corrosive areas require EEMAC 4X and hazardous areas require EEMAC Type 9. Refer to Division 16 for area classifications.

.3 Provide manual overrides on coils when solenoid is used to actuate a valve.

.4 Standard coil voltage: 120 VAC.

.5 Pipe size: 3-way valve - 6mm; 4-way valve - 10mm.

.6 Maximum operating pressure: 850 kPa instrument air.

.7 Minimum operating pressure: 20 kPa instrument air.

3. EXECUTION

3.1 References - General

.1 Refer to Section 17010.

3.2 Tubing and Fitting Installation

.1 Group instruments logically together. Orient instrument air and process connection isolation valves to provide consistent handle indication of normal open/closed status.

.2 Final location of skid mounted instruments to provide sufficient clearance for access to all maintenance settings, to provide unobstructed viewing of instrument indicators and to permit instrument calibration and maintenance during normal operation of the Site.

.3 Tubing installations shall slope down 20 mm per 2 meters of run to process connections.

.4 Support tubing in channel or raceway if exposed or in close proximity to rotating equipment or high traffic areas. Otherwise, do not exceed 1 m between tubing supports.

.5 All turns shall have a minimum bending radius of 50 mm.

.6 Avoid non-terminal connections in tubing runs.

.7 Use Teflon tape on all threaded fittings. Do not apply tape on the first two threads.

.8 Tubing shall terminate at devices with fittings or 90° bends so as to allow removal of tubing without disturbing the device mounting.

.9 Complete the final 300 mm (nominal) of air tubing to instruments or control valves installed in process equipment with flexible reinforced neoprene hose. Support the tubing at the hose connection. Locate the hose connection to facilitate unrestricted removal of the instrument or control valve and to minimize transmission of process equipment vibration into the tubing.

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.

2. PRODUCTS

2.1 Process Taps

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

2.2 Primary Elements

.1 Provide primary elements and transmitters as shown on the Piping and Instrumentation Diagrams (P&IDs) and specified in Division 11.

.2 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.

.3 Provide drip pots for sensing elements measuring gas. Provide seamless, stainless steel drip pots consisting of a 50 mm by 300 mm pipe with an isolating valve and a drain valve. Provide a separate drip pot for each sensing line. Locate the drain valve within 500 mm of the floor.

.4 Provide diaphragm seals for any fluid other than clean water or glycol.

.5 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.

.6 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.

2. PRODUCTS

2.1 Transmitters and Indicators

.1 Provide transmitters and indicators as shown on the Piping and Instrumentation Diagrams (P&IDs) and specified in Division 11.

.2 Transmitters shall have adequate power output to drive all devices associated with the signal loop. Provide signal boosters as required to achieve adequate signal strength or to isolate the signal.

.3 All transmitters to have local indication scaled in engineering units. Provide a lamacoid label indicating the calibrated range and engineering units and mount adjacent to the transmitter. Mount the transmitter so the indicator is visible by operations personnel.

.4 Remote indicators provided by Crompton Instruments, Simpson or Newport are acceptable for use.

.5 Where the Specification calls for a transmitter and an indicator to be mounted in the same panel, an indicating transmitter may be considered acceptable, provided the indicator is normally visible from outside the enclosure.

.6 Where available as an option, the transmitter shall be supplied with an isolated fault contact.

.7 Standard of acceptance for instrumentation shall be as follows:

.1 Magnetic Flow Transmitters: Rosemount 8700 Series, ABB Magmaster, Fischer and Porter, Endress and Hauser.

.2 Thermal Mass Flow Transmitters: ABB, Brooks.

.3 Variable area Flow Transmitters: Omega, Kobold

.4 Pressure Transmitters: Rosemount Model 3051, ABB or Foxboro complete with stainless steel two (2) and three (3) valve manifolds as manufactured by Anderson Greenwood.

.5 Pressure Gauges: Ashcroft, H.O. Trerice, Budenberg.

.6 Ultrasonic Level Transmitters: Siemens Multiranger 100/200, Magnetrol, Endress & Hauser.

.7 Radar Level Transmitters: Endress & Hauser, Siemens, Magnetrol.

.8 Magnetic Level Indication: Krohne, Magnetrol, K-Tek KM26.

.9 Temperature Transmitters (RTD): Rosemount, ABB, Foxboro.

.10 pH Sensors: Rosemount, Endress and Hauser, ABB, Foxboro 870 Series.

.11 Dew/Moisture Measurement: Veronics.

.12 Power Meters: Power Measurement Limited (PML).

.13 Gas Detection Systems: Draeger, MSA, Crowcon.

3. EXECUTION

3.1 References - General

.1 Refer to Section 17010.

END OF SECTION

POWERED ACTUATORS

1. GENERAL

1.1. Work Included

.1 Supply and installation of electric and/or pneumatic powered actuators and accessories for controlled devices such as valves, gates, dampers etc.

.2 Sizing and selection of modulating control valve components.

.3 Size and match powered actuators to controlled devices.

1.2. Related Work

.1 General Process Provisions: Division 11

1.3. Submittals for Review

.1 Provide Submittals in accordance with Division 1 and Section 17010.

.2 Furnish Shop Drawings for complete actuator assemblies and accessories prior to delivery.

.3 Provide calculations for sizing, noise, cavitation and actuator torque calculations, etc., in addition to the requirements of Division 11.

.4 Submit a completed ISA S20.50 Instrument Specification Sheet for each device.

1.4. Submittals for Information Only

.1 Submit the following in addition to the requirements of Division 1 and Section 17010:

.1 Factory calibration and testing reports: Handwritten reports will not be accepted.

.2 Operations and maintenance (O&M) manuals in accordance with Division 11.

1.5. Service Conditions

.1 Provide electrical enclosures rated for wet and corrosive areas.

.2 Control air to be instrument quality, oil free, supplied between 555 kPa minimum to 810 kPa maximum pressure.

.3 Refer to the Instrument Specification Sheets in Section 17701 for process and design conditions.

.4 Refer to Section 17010 for additional details.

1.6. Shipment

.1 Ship equipment in accordance with Division 1 and Section 17010.

1.7. Delivery

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

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

1.8. Process Valve and Actuator Schedules

.1 Refer to the Piping and Instrumentation Diagrams (P&IDs) and the instrument index for valve and actuator identification and for details. Power actuated devices which require automation, as shown on the 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 Manufacturers 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 as an option, actuators shall be provided with Modbus/TCP communications capability.

.6 Tag the control devices, accessories and actuators to indicate operating characteristics. Tag the actuator inlet and outlet ports for electric or pneumatic services. Electric actuators must be Canadian Standards Association (CSA) approved.

.7 Refer to Section 17140 for air sets.

.8 Refer to Section 17140 for solenoid valves.

2.2. Actuator Types

.1 Pneumatic Diaphragm Actuators - General

.1 Provide diaphragm quarter turn and linear actuators capable of continuous duty over the full operating range.

.2 Unless specified otherwise, the actuators shall fail to the open position when the control function fails or when pressure is removed from the actuator diaphragm.

.3 Each actuator shall be capable of operating in any horizontal or vertical orientation.

.4 When manual actuation is specified, fit each actuator with a hand wheel mounted in line with the valve shaft, which will enable manual override control of the valve.

.5 House all internal components in a cast iron enclosure, drip-proof and corrosion-proof.

.2 Pneumatic Diaphragm Quarter Turn Actuators, Modulating Type (PDQM)

.1 Diaphragm operators to be suitable for mounting on quarter turn valves intended for modulating service.

.3 Pneumatic Diaphragm Linear Actuators, Modulating-Type (PDLM)

.1 Diaphragm operators to be suitable for mounting on sliding-stem valves and dampers requiring linear actuation intended for modulating service.

.4 Pneumatic Diaphragm Quarter Turn Actuators, Open/Close-Type (PDQO)

.1 Diaphragm operators to be suitable for mounting on quarter turn valves intended for on/off service.

.2 Provide a solenoid valve, an air set and accessories as detailed on the Instrument Specification Sheets for each actuator.

.3 Provide two needle valves (snubbers) for each actuator. The needle valves control instrument air flows such that the actuator travels a full stroke within a time range adjustable from 1 to 30 seconds with separate adjustments for each direction of travel.

.5 Pneumatic Piston Actuators - General

.1 Provide piston actuators of the type specified on the Instrument Specification Sheets. Two types of quarter-turn pneumatic piston actuators are available: rack and pinion or linkage. Actuators are to be rated for continuous duty over the full operating range.

.2 Unless specified otherwise, the actuators will fail to the open position when the control function fails or when pressure is removed from the actuator diaphragm.

.3 When manual actuation is specified, fit each actuator with a hand wheel to enable manual override control of the valve.

.4 Each actuator shall be capable of operating in any horizontal or vertical orientation.

.5 House internal components in a drip-proof and corrosion proof cast iron enclosure.

.6 Where valves are intended to fail open or closed, provide spring loaded actuators. Where they are intended to fail to last operating position, provide double acting actuators.

.6 Pneumatic Piston Quarter Turn Actuator, Modulating Type (PPQM)

.1 Piston actuators to be suitable for mounting on quarter turn valves or dampers intended for modulating service.

.7 Pneumatic Piston Quarter Turn Actuator, Open/Close Type (PPQO)

.1 Piston operators to be suitable for mounting on quarter turn valves or dampers intended for on/off service. Sector types are not permitted

.2 Provide actuator accessories such as limit switches and position switches as described in the Instrument Specification Sheets and in Section 17216.

.3 Provide two needle valves (snubbers) for each actuator. The needle valves control instrument air flows such that the actuator travels a full stroke within a time range of 1 to 30 seconds with separate adjustments for each direction.

.8 Electro-Mechanical Actuators, General

.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 Limitorque and Rotork.

.9 Electric Quarter Turn Actuators, Open/Close Type (EMQO) and Modulating Type (EMQM)

.1 Provide electric operators suitable for mounting on quarter turn valves or dampers intended for on/off and modulating service.

.2 Provide each actuator with built-in motor overload protection.

.3 Fit each actuator with a hand wheel which will enable manual override control of the valve.

.4 Each actuator shall be capable of operating in any horizontal or vertical orientation.

.5 Provide external mechanical indication of valve position. Provide an external visual position indicator for each positioner.

.6 House internal components in a moisture and corrosion resistant Electrical & Electronic Manufacturer's Association of Canada (EEMAC) 4 enclosure. Internal components shall be permanently lubricated.

.7 Motors will be rated at 20 percent intermittent duty cycle.

.8 For remote indication provide the actuator with two SPDT travel limit switches, 10A, 125 VAC, CSA listed. The travel limit switches to be adjustable.

.9 Provide the actuator with two SPDT torque limit switches, 10A, 125 VAC. The torque limit switches to be factory preset and field adjustable.

.10 Provide adjustable mechanical limit stops to ensure over-turning of the valve does not occur.

.11 Protect exterior mounted actuators against low temperature and condensation.

.12 The actuator speed will be field adjustable.

.13 Provide a terminal board for field wiring. Include contacts to indicate the open/closed status of the valve.

.14 Modulating actuators shall accept a 4-20 mA control signal for remote proportional control.

.10 Electric Linear Actuators, Open/Close Type (EMLO) and Modulating Type (EMLM)

.1 Electric actuators for gates to be comprised of an electric motor and one or two gear boxes, depending on the gate design.

.2 Provide a sufficiently sized motor to seat and unseat gates and, if necessary, for control to traverse from full open to full closed position in small increments in response to control signals.

.3 The actuator will impart a travel speed of 2.5 m/hr to modulating gates and 18.0 m/h to open/close gates unless otherwise specified on the Instrument Specification Sheets. The actuator speed shall be field adjustable.

.4 The actuator shall be fully compatible with the gate. Mount at operating height on the frame.

.5 Actuators to accept 3 phase, 60 Hz power. Protect motors against reverse phase rotation.

.6 The drive train to be rated for heavy duty, continuous service. Connect the actuator drive shaft to gear box shaft(s) through a removable flexible mechanical coupling. Where the actuator is fitted to two stems, ensure that the gearing in each gearbox allows both stems to move identically.

.7 House the internal components of actuators and related gear boxes in weather proof, corrosion proof metal enclosures. Electrical components shall be contained in EEMAC 6 enclosures. All electrical and mechanical components shall be capable of continuous operation in an ambient temperature range of -40°C to plus 40°C.

.8 Provide a space heater for each actuator.

.9 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. Provide a 1:1 gearing ratio with respect to the main drive shaft for the hand wheel.

.10 Fit removable safety guards over all moving drive train components between the actuator and each gear box.

.11 Provide adjustable limit switches on each actuator to define the upper and lower limits of the stroke.

.12 High torque switches will protect the equipment and the structure against excessive gate travel. Provide high torque protection at the lower and upper ends of the stroke.

.13 Provide a controller enclosure to contain a motor contactor complete with overload protection. Provide line, load and external control terminal strips.

.14 Fit each actuator with an electronic positioner to control gate elevation in response to a continuous 4-20 mA DC input signal.

.15 Provide a local operating station with a Computer-Off-Hand switch and an Open-Close switch

2.3. Current to Pneumatic (I/P) Converters

.1 Provide I/P converters where required, as indicated on the Drawings.

.2 Supply all required hardware for mounting the I/P converter on the controlled device.

.3 I/P converter shall be of EEMAC 4 construction.

.4 I/P converter to operate with instrument quality, control air at an operating pressure range of 20 to 200 kPa.

.5 Approved I/P converter Manufacturers are Omega and Moore.

2.4. Valve Positioners

.1 Supply compatible positioners pre-mounted to each actuator. Do not mount the positioner upside down.

.2 Each positioner shall service the entire operating range of the actuator. The equipment position shall be fed back to the positioner through a mechanical linkage.

.3 Positioner shall operate with instrument quality, oil-free control air.

.4 Provide three (3) independent, interchangeable cams for each positioner linear function, square function, and square root function.

.5 Mount a pressure gauge on the positioner to measure air output.

2.5. Position Switches and indicators

.1 Actuator position switches shall include two (2) form C 2 amp contacts in an EEMAC 4 (minimum) rated enclosure.

.2 Cams shall be fastened to a splined shaft and adjustable without set screws.

.3 Provide a visual indicator with beacon type display showing red when the controlled device is open and green when the device is closed.

.4 Supply all required hardware for mounting of the position monitor in accordance with the specified valve/actuator orientation.

.5 Diaphragm actuated valves shall have external position monitor actuated through linkages.

.6 Enclosures are to be suitable for the environment.

2.6. Manual Loading Station

.1 Manual loading station shall consist of a manually adjustable loading regulator, changeover valve (manual/automatic), a gauge for manual signal pressure indication, a gauge for automatic signal pressure indication, an air set, and an air supply isolating valve.

.2 Mount loading station on a galvanized plate attached to a floor stand. Locate station within 2 m of the controlled device.

2.7. Minimum monitoring and control signal requirements

.1 Open/Close actuators:

.1 Momentary Open Command (Remote dry contact).

.2 Momentary Close Command (Remote dry contact).

.3 Open Status (Dry contact for remote indication).

.4 Closed Status (Dry contact for remote indication).

.5 Computer (Remote) Mode (Dry contact for remote indication).

.6 Remote dry contacts will be rated 2 Amps at 120 VAC minimum.

.2 Modulating actuators:

.1 Input signal: 4-20 mA for position control from programmable logic controller (PLC).

.2 Output signal: 4-20 mA to PLC for position monitoring.

.3 Computer (Remote) Mode (Dry contact for remote indication).

3. EXECUTION

3.1. Field Testing and Commissioning

.1 Provide performance and installation verification in accordance with Division 1 and Section 17010, Part 3.

.2 Factory test each actuator assembly prior to shipment.

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.

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.

.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

SIGNAL CONDITIONING MODULES

1. GENERAL

1.1 References - General

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

2. PRODUCTS

2.1 Signal Conditioning Modules

.1 Where required, provide signal conditioning modules that comply with the following requirements, unless otherwise specified:

.1 Analog signal inputs: 4-20 mA DC into 500 ohms.

.2 Analog signal outputs: 4-20 mA DC into 500 ohms.

.3 Discrete output contacts: SPDT rated 5A, 120 VAC.

.4 Arrange electronic trips so that output contact opens in case of loss of signal or loss of power supply.

.5 Modules to be rated for continuous operation in an ambient temperature of 0 to 80°C. Ambient temperature effect not to exceed plus or minus 0.01% per °C within that range.

.6 Span and zero adjustments to be made by front accessible multi-turn potentiometers or keypad.

.7 Provide electronic trip modules with L.E.D. indicators for relay status.

.8 Modules to withstand 30 volts per meter radio frequency radiation between 200 and 500 MHz with not more than 0.25% calibration effect. Provide modules with traps on the terminals to shunt conducted radio frequency interference to ground.

.9 Galvanically isolate signal and power supply terminals from the case.

.2 All modules specified in this Section to be the Product of a single Manufacturer.

2.2 Current to Pneumatic (I/P) Converters

.1 Refer to Section 17213 – Powered Actuators, Item 2.3.

3. EXECUTION

3.1 References – General

.1 Refer to Section 17010 – Instrumentation and Control General Requirements, Part three (3).

END OF SECTION

PANEL INSTRUMENTS

1. GENERAL

1.1 References - General

.1 Equipment, Products and Execution must meet all requirements detailed in Section 17010.

2. PRODUCTS

2.1 Electronic Panel Instruments

.1 Provide panel instruments with the following requirements, unless otherwise specified:

.1 Analog instruments to be miniature-case draw-out type nominally 150 mm high by 75 mm wide by not more than 350 mm deep.

.2 Make the operator, tuning and configuration adjustments accessible without disconnecting the instrument from the process.

.3 Analog signal indicators to be solid state, LED or gas-discharge type, including bar-graph displays with not less than 200 segments. Backlit LCD indication is also acceptable.

.4 Analog signal inputs to be 4-20 mA VDC.

.5 Analog signal outputs to be 4-20 mA VDC into 500 ohms.

.6 Galvanically isolate the signal and power supply from the instrument case.

.2 Panel instruments specified in this Section are to be the Product of a single Manufacturer, and to match and line up to form an integrated appearance and operator interface strategy. Approved Manufacturers are Crompton Instruments and Simpson.

3. EXECUTION

3.1 References - General

.1 Refer to Section 17010.

END OF SECTION

MISCELLANEOUS PANEL DEVICES

1. GENERAL

1.1 References - General

.1 Equipment, Products and Execution must meet all requirements detailed in Section 17010.

2. PRODUCTS

2.1 Miscellaneous Panel Devices

.1 Pilot Lights

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

.2 Terminals

.1 Provide strap screw type terminal blocks rated for 600 volts.

.2 Identify each terminal block within an enclosure with a unique machine printed terminal block number. Cabinet chassis grounding terminal blocks are to be identified by the electrical ground symbol.

.3 Connections to screw terminals to be locking fork tongue insulated crimp type wire connectors.

.4 Terminals to be Weidmuller or approved equal.

.5 Provide a group of terminals for each of 120 VAC hot and neutral, 120 VAC UPS hot and neutral and 24 VDC positive and negative power. Distribution wiring to have a thermal magnetic circuit breaker upstream of all major blocks of loads, adequately sized to protect the connected load while not causing nuisance tripping.

.6 Provide Weidmuller disconnect type terminal blocks for each load or loop powered from the marshalling panels.

.3 Nameplates

.1 Refer to Section 17010 for nameplate Specification.

2.2 Signal Current Isolator

.1 Isolators shall be installed to provide galvanic isolation of milliamp transmission signals from transmitters with inadequately isolated output circuits.

.2 Isolator to be housed in a NEMA 250, Type 4/7 conduit body and derive its operating power from the signal input circuit.

.3 Input and output signals shall be 4-20 mA, with an error not exceeding 0.1 percent of span. Input resistance will not exceed 550 ohms with an output load of 250 ohms.

.4 Approved Manufacturers are Moore Industries, Weidmuller or Phoenix.

2.3 Intrinsic Safety Barriers and Relays

.1 Provide intrinsic safety barriers where required for two-wire transmitters of the active, isolating, loop powered type; MTL Type MT3042, Stahl 9005/01-252/100/00, Pepperl & Fuchs ZG series, or approved equal.

.2 Provide dual type intrinsic safety barriers for process switches; MTL 787, Panalarm 201-BR2.

.3 Intrinsic safety relays to be Gems or Warrick.

2.4 Industrial Ethernet Switches

.1 Install Ethernet Switches in all control panels housing PLCs that interface to the plant control and operator interface network. Connect to PLC's, meters and all other Ethernet capable equipment resident within the control panel using cable rated for 100 Base-TX communication.

.2 Switches shall comply with Institute of Electrical and Electronic Engineers (IEEE) 802.3, 802.3u, 802.3x, 802.1D.

.3 Switches shall include a minimum of 5 10/100 Base T(x) RJ45 Ports and 2 multimode 100 Base FX Fiber ports.

.4 Switches shall include one (1) relay output alarm contact rated for 1A@24VDC.

.5 Input power shall be capable of ranging from 9 to 32 VDC with redundant inputs.

.6 Switches shall be fast spanning for a sub-second recovery in a ring configuration.

.7 Switches shall be Eagle Technology ED6008 Series, Schneider ConneXium Series or approved equal.

2.5 Fiber Termination Panel

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

3. EXECUTION

3.1 References - General

.1 Refer to Section 17010, Part 3.

END OF SECTION

PROGRAMMABLE LOGIC CONTROLLERS

1. GENERAL

1.1 References - General

.1 Equipment, Products and Execution must meet all requirements detailed in Section 17010.

1.2 Work Included

.1 Design, supply, and installation of a programmable logic controller (PLC)-based control system that will control and monitor the system in accordance with the requirements defined in Division 11.

.2 PLC's and Inputs/Outputs (I/O) shall be housed in a central control panel.

.3 PLC's shall be programmed using the latest version of Schneider Electric's Unity Programming Software. The program shall be fully documented and programmed according to standards that will be provided by the Contract Administrator.

.4 The final PLC configuration program shall be provided to the City on compact disk.

.5 Start-up and commissioning assistance as required for the control system.

1.3 Related Work

.1 General Process Provisions: Division 11

2. PRODUCTS

2.1 PLC's

.1 General

.1 All new PLC equipment to be based on the Modicon Unity Processor family as applicable (no substitutions allowed).

.2 All PLC's shall be Unity hot standby processors complete with redundant processors.

.3 Communication protocol for the PLC network shall be Modbus/TCP. Ethernet communication modules shall be provided in each PLC rack to interface to the plant control network.

.4 Provide all necessary racks, power supplies, cables, communication cards, and accessories.

.5 Provide spares of all PLC system components (minimum of one of each exact type) supplied including: power supply, processor, communication modules, and input/output modules.

.6 Provide 10% spare slot capacity for each PLC panel assembly.

.7 Provide 25% spare power supply capacity for each PLC panel assembly.

.8 PLC racks shall be powered from the external uninterruptible power supply (UPS) system. Each new PLC panel assembly shall include Sola Hevi-Duty STV100K series incoming power transient surge suppression or approved equal. Connect the surge suppressor dry contact to a PLC input and configure as an alarm on the control system at each panel.

.2 PLC

.1 Modicon Unity main processor and hot standby CPU: Model Number 140 CPU 671 60.

.2 Modicon NOE (Modbus/TCP) modules for each processor rack.

.3 Redundant cable remote I/O modules in each rack: Model Numbers 140 CRP 932 00 and 140 CRA 932 00.

.4 I/O modules to meet the Specifications defined above and the I/O requirements of Section 11490, 11.

.3 I/O

.1 120 VAC Digital Inputs: Model Number 140 DAI 540 00.

.2 24 VDC Digital Inputs: Model Number 140 DAI 340 00.

.3 Digital Outputs: Model Number 140 DAO 840 00.

.4 Analog Inputs: Model Number 140 ACI 030 00.

.5 Analog Outputs: Model Number 140 ACO 020 00.

.6 Provide at least 20% spare I/O of each type in each panel assembly.

2.2 System Integration Requirements

.1 Cooperate with other Contractors, City staff, and consultants to facilitate installation, testing, validation, and commissioning of the control system.

.2 Supply, Install, test, and commission the PLC Control Panel as specified in this Section and as shown on the Drawings.

.3 Assist the Systems Integrator to establish communication with the PLC's. Test data exchange between the PLC's and the plant control network as defined in this Section and the process description.

3. EXECUTION

3.1 References – General

.1 Refer to Section 17010, Part three (3).

END OF SECTION

OPERATOR INTERFACE REQUIREMENTS

1. GENERAL

1.1 References – General

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

1.2 General Requirements

.1 Local Control and Operator Interface Requirements

.1 Provide all necessary local controls to allow local operation that compliments the operation of the plant control system and facilitates satisfactory system control consistent with the intent of this Specification. The extent of local controls to be provided shall be fully described as part of the submittals defined in Division 11.

.2 Provide a local operator interface consisting of an industrial grade PC complete with graphical interface software that has been configured for the application.

.3 The graphical interface software shall be fully documented and programmed according to standards that will be provided by the Contract Administrator.

.4 The final graphical interface configuration shall be fully documented and shall be provided to the City on compact disk prior to Substantial Performance.

.5 Configuration software and all associated licenses and tools required to maintain and re-configure the software shall be provided to the City prior to Substantial Performance.

.6 Detailed local control and operator interface requirements are defined in Division 11.

.2 Interface to the Water Treatment Plant Control System

.1 The Operator Interface to the plant control system will be supplied, installed, programmed, and commissioned by others. The Contractor shall provide all information necessary for the systems integrator to create a complete and comprehensive remote monitoring and control system consistent with the requirements of this document.

.2 This Contractor is to support the design, installation, programming, and start-up of the plant control system as follows:

.1 Supply all field instrumentation necessary to facilitate both local and remote monitoring and control of the system.

.2 Provide all hardware interfaces required to facilitate the interconnection of the contractor supplied PLC control system to the plant control system.

.3 Provide all written descriptions and associated Drawings necessary to fully describe the detailed operation of the entire system supply and to allow the control system integrator to develop application software on the plant operator interface network. This includes the PLC control logic software, recommended operator interface points, alarm lists, recommended historical trend and long-term data storage points, PLC tag lists and sample graphics screens as developed for the local operator interface, either as print-out or in electronic bitmap format.

.4 Update all system documentation at the completion of commissioning and start-up to reflect the final installation.

.3 For the purpose of this project, the tag name convention used on the I/O lists included with the specifications and shown on the Piping and Instrumentation Diagrams (P&IDs) will be used. Coordinate the implementation of tags for any instrumentation not listed with the Contract Administrator.

2. PRODUCTS

2.1 Local Human Machine Interface

.1 Provide a local operator interface consisting of an industrial grade PC complete with an application specific graphical interface configured using InTouch Version 9.0 HMI software by ISS Wonderware, OASyS DNA by Telvent, or approved equal. The industrial grade PC shall be provided with the HMI software provider's recommended system hardware and operating system.

.2 Minimum requirements of the industrial PC are as follows:

.1 15 inch color flat screen display

.2 Membrane keypad and mouse

.3 Dual Ethernet ports.

3. EXECUTION

3.1 Performance – General

.1 Refer to Section 17010, Part three (3).

3.2 Installation

.1 Provide hardware in accordance with the foregoing requirements in sufficient quantity to satisfy the performance requirements defined in this and other Divisions of this Specification.

.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 defined herein.

.4 Provide all documentation and training as defined herein.

END OF SECTION