THE CITY OF WINNIPEG

BID OPPORTUNITY

BID OPPORTUNITY NO. 37-2006

WINNIPEG WATER TREATMENT PROGRAM – SURGE TOWER CONSTRUCTION

Template Version: C220050301

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PART B - BIDDING PROCEDURES

B1. PROJECT TITLE

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B2. SUBMISSION DEADLINE

B2.1 The Submission Deadline is 12:00 noon Winnipeg time, June 2, 2006.

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

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

B3. SITE INVESTIGATION

B3.1 Further to GC:3.1, the Contract Administrator or an authorized representative will be available at the Site from 11:00 a.m. to 12:00 noon on May 18, 2006 to provide Bidders access to the Site.

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

B4. ENQUIRIES

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

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

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

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

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

B5. ADDENDA

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

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

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

B5.2.2 The Bidder is responsible for ensuring that he has received all addenda and is advised to check the Materials Management Branch internet site for addenda shortly before submitting his Bid.

B5.3 The Bidder shall acknowledge receipt of each addendum in Paragraph 10 of Form A: Bid. Failure to acknowledge receipt of an addendum may render a Bid non-responsive.

B6. SUBSTITUTES

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

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

B6.3 Requests for approval of a substitute will not be considered unless received in writing by the Contract Administrator at least seven (7) Business Days prior to the Submission Deadline.

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

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

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

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

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

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

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

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

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

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

B6.8 If the Contract Administrator approves a substitute as an “approved alternative”, any Bidder bidding that approved alternative shall base his Total Bid Price upon the specified item but may also indicate an alternative price based upon the approved alternative. Such alternatives will be evaluated in accordance with B15.

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

B7. BID SUBMISSION

B7.1 The Bid Submission consists of the following components:

(a) Form A: Bid;

(b) Form B: Prices;

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

B7.2 All components of the Bid Submission shall be fully completed or provided, and submitted by the Bidder no later than the Submission Deadline, with all required entries made clearly and completely in ink, to constitute a responsive Bid.

B7.3 The Bid Submission shall be submitted enclosed and sealed in an envelope clearly marked with the Bid Opportunity number and the Bidder's name and address.

B7.3.1 Samples or other components of the Bid Submission which cannot reasonably be enclosed in the envelope may be packaged separately, but shall be clearly marked with the Bid Opportunity number, the Bidder's name and address, and an indication that the contents are part of the Bidder’s Bid Submission.

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

B7.5 Bid Submissions shall be submitted to:

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

B8. BID

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

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

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

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

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

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

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

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

B8.4 Paragraph 12 of Form A: Bid shall be signed in accordance with the following requirements:

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

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

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

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

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

B8.4.2 All signatures shall be original and shall be witnessed except where a corporate seal has been affixed.

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

B9. PRICES

B9.1 The Bidder shall state the lump sum price in Canadian funds for the Work on Form B: Prices.

B10. QUALIFICATION

B10.1 The Bidder shall:

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

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

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

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

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

(f) employ only Subcontractors who:

(i) are responsible and not suspended, debarred or in default of any obligation to the City (a list of suspended or debarred individuals and companies is available on the Information Connection page at The City of Winnipeg, Corporate Finance, Materials Management Branch internet site at http://www.winnipeg.ca/matmgt); and

(ii) have successfully carried out work similar in nature, scope and value to the portion of the Work proposed to be subcontracted to them, and are fully capable of performing the Work required to be done in accordance with the terms of the Contract;

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

B10.2 Further to B10.1(g), the Bidder shall, within three (3) Business Days of a request by the Contract Administrator, provide proof satisfactory to the Contract Administrator that the Bidder has a workplace safety and health program meeting the requirements of The Workplace Safety and Health Act (Manitoba), by providing:

(a) a valid COR certification number under the Certificate of Recognition (COR) Program - Option 1 administered by the Manitoba Heavy Construction Association's Safety, Health and Environment Program; or

(b) a valid COR certification number under the Certificate of Recognition (COR) Program administered by the Manitoba Construction Safety Association; or

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

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

B10.4 The Bidder shall provide, on the request of the Contract Administrator, full access to any of the Bidder's equipment and facilities to confirm, to the Contract Administrator's satisfaction, that the Bidder's equipment and facilities are adequate to perform the Work.

B11. BID SECURITY

B11.1 The Bidder shall provide bid security in the form of:

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

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

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

B11.1.1 If the Bidder submits alternative bids, the bid security shall be in the amount of the specified percentage of the highest Total Bid Price submitted.

B11.2 The bid security of the successful Bidder and the next two lowest evaluated responsive and responsible Bidders will be released by the City when a Contract for the Work has been duly executed by the successful Bidder and the performance security furnished as provided herein. The bid securities of all other Bidders will be released when a Contract is awarded.

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

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

B11.3 The bid securities of all Bidders will be released by the City as soon as practicable following notification by the Contract Administrator to the Bidders that no award of Contract will be made pursuant to the Bid Opportunity.

B12. OPENING OF BIDS AND RELEASE OF INFORMATION

B12.1 Bid Submissions will be opened publicly, after the Submission Deadline has elapsed, in the office of the Corporate Finance Department, Materials Management Branch, or in such other office as may be designated by the Manager of Materials.

B12.1.1 Bidders or their representatives may attend.

B12.1.2 Bid Submissions determined by the Manager of Materials, or his designate, to not include the bid security specified in B11 will not be read out.

B12.2 After the public opening, the names of the Bidders and their Total Bid Prices as read out (unevaluated, and pending review and verification of conformance with requirements) will be available on the Closed Bid Opportunities (or Public/Posted Opening & Award Results) page at The City of Winnipeg, Corporate Finance, Materials Management Branch internet site at http://www.winnipeg.ca/matmgt.

B12.3 After award of Contract, the name(s) of the successful Bidder(s) and the Contract Amount(s) will be available on the Closed Bid Opportunities (or Public/Posted Opening & Award Results) page at The City of Winnipeg, Corporate Finance, Materials Management Branch internet site at http://www.winnipeg.ca/matmgt.

B12.4 The Bidder is advised that any information contained in any Bid Submission may be released if required by City policy or procedures, by The Freedom of Information and Protection of Privacy Act (Manitoba), by other authorities having jurisdiction, or by law.

B13. IRREVOCABLE BID

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

B13.2 The acceptance by the City of any Bid shall not release the Bids of the next two lowest evaluated responsive Bidders and these Bidders shall be bound by their Bids on such Work until a Contract for the Work has been duly executed and the performance security furnished as herein provided, but any Bid shall be deemed to have lapsed unless accepted within the time period specified in Paragraph 11 of Form A: Bid.

B14. WITHDRAWAL OF BIDS

B14.1 A Bidder may withdraw his Bid without penalty by giving written notice to the Manager of Materials at any time prior to the Submission Deadline.

B14.1.1 Notwithstanding GC:23.3, the time and date of receipt of any notice withdrawing a Bid shall be the time and date of receipt as determined by the Manager of Materials.

B14.1.2 The City will assume that any one of the contact persons named in Paragraph 3 of Form A: Bid or the Bidder's authorized representatives named in Paragraph 12 of Form A: Bid, and only such person, has authority to give notice of withdrawal.

B14.1.3 If a Bidder gives notice of withdrawal prior to the Submission Deadline, the Manager of Materials shall:

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

(b) open the Bid Submission to identify the contact person named in Paragraph 3 of Form A: Bid and the Bidder's authorized representatives named in Paragraph 12 of Form A: Bid; and

(c) if the notice has been given by any one of the persons specified in B14.1.3(b), declare the Bid withdrawn.

B14.2 A Bidder who withdraws his Bid after the Submission Deadline but before his Bid has been released or has lapsed as provided for in B13.2 shall be liable for such damages as are imposed upon the Bidder by law and subject to such sanctions as the Chief Administrative Officer considers appropriate in the circumstances. The City, in such event, shall be entitled to all rights and remedies available to it at law, including the right to retain the Bidder's bid security.

B15. EVALUATION OF BIDS

B15.1 Award of the Contract shall be based on the following bid evaluation criteria:

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

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

(c) Total Bid Price;

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

B15.2 Further to B15.1(a), the Award Authority may reject a Bid as being non-responsive if the Bid Submission is incomplete, obscure or conditional, or contains additions, deletions, alterations or other irregularities. The Award Authority may reject all or any part of any Bid, or waive technical requirements if the interests of the City so require.

B15.3 Further to B15.1(b), the Award Authority shall reject any Bid submitted by a Bidder who does not demonstrate, in his Bid Submission or in other information required to be submitted, that he is responsible and qualified.

B15.4 Further to B15.1(c), the Total Bid Price shall be the lump sum price shown on Form B: Prices.

B15.4.1 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.

B16. AWARD OF CONTRACT

B16.1 The City will give notice of the award of the Contract by way of a letter of intent, or will give notice that no award will be made.

B16.2 The City will have no obligation to award a Contract to a Bidder, even though one or all of the Bidders are determined to be responsible and qualified, and the Bids are determined to be responsive.

B16.2.1 Without limiting the generality of B16.2, the City will have no obligation to award a Contract where:

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

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

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

(d) only one Bid is received; or

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

B16.3 Where an award of Contract is made by the City, the award shall be made to the responsible and qualified Bidder submitting the lowest evaluated responsive Bid.

PART C - GENERAL CONDITIONS

C1. GENERAL CONDITIONS

C1.1 The *General Conditions for Construction Contracts* (Revision 2000 11 09) are applicable to the Work of the Contract.

C1.1.1 The *General Conditions for Construction Contracts* 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 Construction Contracts*, 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 “Tender Package” wherever it appears in the General Conditions and substituting “Bid Opportunity”.

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

D1.5 The General Conditions are amended by deleting GC:6.16 and GC:6.17. The City of Winnipeg is now within the jurisdiction of the Manitoba Ombudsman pursuant to The Ombudsman Act.

D2. SCOPE OF WORK

D2.1 The Work to be done under the Contract shall consist of the construction of a surge tower for a piped water system.

D2.2 The major component of the Work is as follows:

(a) a concrete structure with a piled foundation, temporary pipe support system, insulated and metal clad exterior finish, insulated roof system, mechanical piping, electrical and controls.

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) **Supply Contractor** means a contractor retained by the City, under a separate contract, to supply City Supplied Equipment which shall be installed by the Contractor;

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

(e) **City Supplied Equipment** means equipment purchased by the City under a separate contract which is supplied into the care of the Contractor for installation under this Contract.

(f) **Substantial Performance** shall have the meaning attributed to it in the Builders’ Liens Act (Manitoba), or any successor legislation thereto.

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

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

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

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

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

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

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

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

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

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

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

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

(s) **Manufacturer** means the person, partnership or corporation responsible for the manufacture and fabrication of equipment supplied by the Contractor for the completion of the Work.

(t) **Manufacturer's Representative** means a trained serviceman empowered by the Manufacturer to provide installation, testing, and commissioning assistance to the Contractor in his performance of those functions.

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

(v) **NEMA** means National Electrical Manufacturer's Association

(w) **Furnish** means supply

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

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

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

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

(bb) **EEMAC** means Electrical and Electronic Manufacturer Association of Canada

(cc) **VFD** means variable frequency drive

(dd) **VSD** means variable speed drive

(ee) **TPSH** means twisted pair shielded cable

(ff) **RTD** means resistance temperature detector

(gg) **LOX** means liquid oxygen

(hh) **GOX** means gaseous oxygen

(ii) **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

(jj) **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

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

(ll) **Major Equipment** means all equipment for which Shop Drawing submittals are required as specified herein.

(mm) **Performance Verification** means all factory and field tests, demonstrations and other activities required from the Contractor to complete all required Forms 103 – Certificate of Satisfactory Performance and to demonstrate to the Contract Administrator's satisfaction that the equipment installed under this Contract is performing as specified herein.

(nn) **Certified Shop Drawings** means Shop Drawings prepared by the Contractor after all required Shop Drawings have been "reviewed" or "reviewed as modified" in accordance with Section 01300 of this Bid Opportunity and which incorporate all modifications to the Shop Drawings, comments and notations made by the Contract Administrator in the course of the review.

(oo) **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.

(pp) **Process Unit** means a complete equipment package supplied either by the Contractor or as part of City Supplied Equipment and which includes individual process components, skid mounted equipment and any related appurtenances.

(qq) **Control System Integrator** means a contractor retained by the City (under a different contract) to program and configure the Water Treatment Plant SCADA system.

(rr) **Systems Integrator** means Control Systems Integrator.

(ss) **SCADA** means supervisor control and data acquisition.

(tt) **TGS** means Manitoba Transportation and Government Service.

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

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

(ww) **City Warehouse** means the enclosed and heated City owned warehouse located at 1500 Plessis Road, Winnipeg, Manitoba.

(xx) **Commissioning Period** means the time between the completion of Performance Verification and Total Performance during which a system is operated under Commissioning Operations Agent's control to demonstrate to the City it that it operates in conformance with the design intent

(yy) **Commissioning Operations Agent** means a qualified maintenance/operations team, retained by the City under a separate contract, that takes primary responsibility for operation and maintenance of the WTP during the System Demonstration Period

(zz) **Certified Shop Drawings** means Shop Drawings prepared by the Contractor after all required Shop Drawings have been "reviewed" or "reviewed as modified" in accordance with Section 01300 of this Bid Opportunity and which incorporate all modifications to the Shop Drawings, comments and notations made by the Contract Administrator in the course of the review.

(aaa) **Record Drawings** means a minimum of one (1) complete set of Contract Documents and Certified Shop Drawings maintained at the Contractor's Site office on which the Contractor clearly shall clearly record in red pencil all Addenda, Change Orders, Field Instructions, and other revisions or as-built conditions which deviate from the original Contract Documents or Certified Shop Drawings.

(bbb) **O&M** means operation and maintenance

(ccc) **I&C** means instrumentation and control

(ddd) **AASHTO** means American Association of State Highway and Transportation Officials

(eee) **UV** means ultraviolet

(fff) **PVC** means polyvinyl chloride

(ggg) **ULC** means Underwriter's Laboratories of Canada

(hhh) **ASHRAE** means American Society of Heating, Refrigerating, and Air Conditioning Engineers

(iii) **AWS** means American Welding Society

(jjj) **NFPA** means National Fire Protection Association

(kkk) **OSHA** means Occupational Safety and Health Act

(lll) **FS** means Federal Specifications

(mmm) **AFBMA** means Anti-Friction Bearing Manufacturer's Association

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

(ooo) **PLC** means programmable logic controller

(ppp) **I/O** means input/output

(qqq) **UHMWPE** means ultra high molecular weight polyethylene

(rrr) **NPSH** means net positive suction head

(sss) **NPSHR** means net positive suction head required

(ttt) **TEFC** means totally enclosed fan-cooled

(uuu) **ABMA** means American Bearing Manufacturer's Association

(vvv) **BEP** means best efficiency point

(www) **PTC** means positive thermal protection

(xxx) **ODP** means open drip proof

(yyy) **CEMA** means Canadian Electrical Manufacturer's Association

(zzz) **TDH** means total dynamic head

(aaaa) **SSPC** means Steel Structures Painting Council

(bbbb) **P&ID** means process and instrumentation diagram

(cccc) **ILD** means instrument loop diagram

(dddd) **HMI** means human machine interface

(eeee) **UPS** means uninterruptible power supply

(ffff) **MCC** means motor control centre

(gggg) **NLGA** means National Lumber Grades Authority

(hhhh) **CUFCA** means Canadian Urethane Foam Contractor Association

(iiii) **SBS** means Styrene-Butadiene-Styrene

(jjjj) **EPDM** means Ethylene Propylene Diene Monomer

(kkkk) **CSDFMA** means Canadian Steel Door and Frame Manufacturers' Association

(llll) **Vendor Package** means a manufactured equipment package supplied and installed by the Contractor.

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

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

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

D4. CONTRACT ADMINISTRATOR

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

Lawrence Recksiedler, C.E.T.
1479 Buffalo Place
Winnipeg, MB, R3T 1L7

e-mail: lawrence.recksiedler@uma.aecom.com

Telephone No. (204) 986-4246
Facsimile No. (204) 986-8393

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

D5. CONTRACTOR'S SUPERVISOR

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

D6. NOTICES

D6.1 Except as provided for in GC:23.2.2, all notices, requests, nominations, proposals, consents, approvals, statements, authorizations, documents or other communications to the Contractor shall be sent to the address or facsimile number identified by the Contractor in Paragraph 2 of Form A: Bid.

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

D6.3 All notices of appeal to the Chief Administrative Officer shall be sent to 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

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

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

Facsimile No.: (204) 947-9155

D7. FURNISHING OF DOCUMENTS

D7.1 Upon award of the Contract, the Contractor will be provided with five (5) complete sets of the Bid Opportunity. If the Contractor requires additional sets of the Bid Opportunity, they will be supplied to him at cost.

SUBMISSIONS

D8. SAFE WORK PLAN

D8.1 The Contractor shall provide the Contract Administrator with a Safe Work Plan at least five (5) Business Days prior to the commencement of any Work on the Site but in no event later than the date specified in GC:4.1 for the return of the executed Contract.

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

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.

D9.3 The Contractor shall not cancel, materially alter, or cause each policy to lapse without providing at least fifteen (15) Calendar Days prior written notice to the Contract Administrator.

D10. PERFORMANCE SECURITY

D10.1 The Contractor shall provide and maintain performance security until the expiration of the warranty period in the form of:

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

(b) an irrevocable standby letter of credit issued by a bank or other financial institution registered to conduct business in Manitoba and drawn on a branch located in Winnipeg, in the form attached to these Supplemental Conditions (Form H2: Irrevocable Standby Letter of Credit), in the amount of fifty percent (50%) of the Contract Price; or

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

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

D10.2 If the bid security provided in his Bid Submission was not a certified cheque or draft pursuant to B11.1(c), the Contractor shall provide the City Solicitor with the required performance security within seven (7) Calendar Days of notification of the award of the Contract by way of letter of intent and prior to the commencement of any Work on the Site but in no event later than the date specified in GC:4.1 for the return of the executed Contract.

D11. DETAILED PRICES

D11.1 The Contractor shall provide the Contract Administrator with a detailed price breakdown in a format acceptable to the Contract Administrator 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:4.1 for the return of the executed Contract.

D12. SUBCONTRACTOR LIST

D12.1 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:4.1 for the return of the executed Contract.

D13. DETAILED WORK SCHEDULE

D13.1 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.

D13.2 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.

D13.3 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.

D13.4 Upon acceptance by the Contract Administrator, distribute copies of the revised schedule to Subcontractors and other concerned parties.

D13.5 The Contract Work Schedule shall be updated as the work requires and submitted to the Contract Administrator.

D13.6 The Contractor shall instruct recipients to report to the Contractor immediately any problems anticipated by the timetable shown in the Contract Work Schedule.

D13.7 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.

D13.8 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.

D13.9 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.

D13.10 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.

D14. SECURITY CLEARANCE

D14.1 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.

D14.2 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.

D14.3 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.

D14.4 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.

D14.5 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.

D15. SHOP DRAWING SUBMITTAL LIST

D15.1 Within forty (40) Business Days of the award date, the Contractor shall submit a complete list of all required submittals with specification Section numbers, description of item and estimated dates for submittals. This submittal list must be in electronic spreadsheet format in Microsoft Excel software.

SCHEDULE OF WORK

D16. COMMENCEMENT

D16.1 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.

D16.2 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 GC:6.14;

(iii) the Safe Work Plan specified in D8;

(iv) evidence of the insurance specified in D9;

(v) the performance security specified in D10;

(vi) the detailed prices specified in D11;

(vii) the Subcontractor list specified in D12;

(viii) the detailed work schedule specified in D13; and

(ix) the security clearances specified in D14.

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

D16.3 The Contractor shall commence the Work on the Site within fifteen (15) Business Days of receipt of the letter of intent.

D17. CRITICAL STAGES

D17.1 The Contractor shall achieve critical stages of the Work in accordance with the following requirements:

(a) The Contractor shall complete the installation of the temporary pipe supports as noted in Item 5 of the construction sequence (Drawing WY-S0453) within ten working days from the commencement of the Work noted in Item 5 but in no event later than September 15, 2006.

(b) December 4, 2006 – Completion of overflow pipe complete with concrete encasement and ready for connection of yard piping (by other contract).

(c) May 11, 2007 – Complete demolition of existing 1200 mm diameter pipe designated for removal, pipe repairs and disinfection of the surge tower.

D18. SUBSTANTIAL PERFORMANCE

D18.1 The Contractor shall achieve Substantial Performance by June 30, 2007.

D18.2 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.

D18.3 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.

D19. TOTAL PERFORMANCE

D19.1 The Contractor shall achieve Total Performance by July 31, 2007.

D19.2 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.

D19.3 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.

D20. LIQUIDATED DAMAGES

D20.1 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) Critical stages as specified in D17.1 - two thousand six hundred dollars ($2,600);

(b) Substantial Performance – two thousand six hundred dollars ($2,600);

(c) Total Performance – six hundred dollars ($600).

D20.2 The amounts specified for liquidated damages in D20.1 are 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.

D20.3 The City may reduce any payment to the Contractor by the amount of any liquidated damages assessed.

D20.4 The City will not pay a bonus if critical stages, Substantial Performance or Total Performance is achieved before the dates specified.

CONTROL OF WORK

D21. JOB MEETINGS

D21.1 Regular weekly job meetings will be held at the Site. These meetings shall be attended by a minimum of one representative of the Contract Administrator, one representative of the City and one representative of the Contractor. Each representative shall be a responsible person

capable of expressing the position of the Contract Administrator, the City and the Contractor respectively on any matter discussed at the meeting including the Work schedule and the need to make any revisions to the Work schedule. The progress of the Work will be reviewed at each of these meetings.

D21.2 The Contract Administrator reserves the right to cancel any job meeting or call additional job meetings whenever he deems it necessary.

D22. PRIME CONTRACTOR – THE WORKPLACE SAFETY AND HEALTH ACT (MANITOBA)

D22.1 Further to GC:6.26, 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 Safety and Health Management Plan. Compliance with this Plan will be mandatory for all personnel on the construction site and orientation of all staff by the Prime Contractor's Safety Officer will be required. Further to GC:6.26, the Contractor shall be the Prime Contractor and shall serve as, and have the duties of the Prime Contractor in accordance with The Workplace Safety and Health Act (Manitoba).

(a) The Water Treatment Program Project Safety and Health Management Plan is available on the City of Winnipeg, Corporate Finance, Materials Management Branch internet site at http://www.winnipeg.ca/matmgt/projects.

MEASUREMENT AND PAYMENT

D23. PAYMENT SCHEDULE

D23.1 Further to GC:12, payment shall be in accordance with the following payment schedule:

(a) The lump sum price listed in Form B: Prices will be paid on the basis of monthly progress estimates in accordance with GC:12 and the detailed price breakdown prepared pursuant to D11.

WARRANTY

D24. WARRANTY

D24.1 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.

D24.2 Notwithstanding GC.10.01, GC.10.02 and D24.1, 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.

D24.3 Notwithstanding GC:13.2, the warranty period shall begin on the date of Total Performance and shall expire one (1) year thereafter, except where longer warranty periods are specified in the respective Specification sections, unless extended pursuant to GC:13.2.1 or GC:13.2.2, in which case it shall expire when provided for thereunder.

D24.3.1 For the purpose of Performance Security, the warranty period shall be one (1) year.

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. 37-2006

WINNIPEG WATER TREATMENT PROGRAM – SURGE TOWER CONSTRUCTION

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. 37-2006

WINNIPEG WATER TREATMENT PROGRAM – SURGE TOWER CONSTRUCTION

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 D12)

WINNIPEG WATER TREATMENT PROGRAM – SURGE TOWER CONSTRUCTION

Name	Address

PART E - SPECIFICATIONS

GENERAL

E1. APPLICABLE SPECIFICATIONS, STANDARD DETAILS AND DRAWINGS

E1.1 *The City of Winnipeg Standard Construction Specifications* in its entirety, whether or not specifically listed on Form B: Prices, shall apply to the Work.

E1.1.1 *The City of Winnipeg Standard Construction Specifications* is available on the Information Connection page at The City of Winnipeg, Corporate Finance, Materials Management Branch internet site at http://www.winnipeg.ca/matmgt.

E1.1.2 The version in effect three (3) Business Days before the Submission Deadline shall apply.

E1.1.3 Further to GC:2.4(d), Specifications included in the Bid Opportunity shall govern over *The City of Winnipeg Standard Construction Specifications*.

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

Consultant Drawing No.	City Drawing No.	Title
CM G001		CONSTRUCTION SITE LAYOUT
CM G003		CONSTRUCTION SITE LAYOUT
D-1223		DEACON RESERVOIR – STAGE 1 – AQUEDUCT CONNECTION - DETAILS
D-1225		DEACON RESERVOIR – STAGE 1 – PLAN – PROFILE – OUTLET CONDUIT & PIPE
D-1232		DEACON RESERVOIR – STAGE 1 – OUTLET CONTROL – VALVE CHAMBER
D-2851		DEACON BOOSTER PUMPING STATION - MCP - VC-6 VALVE
D-2853		DEACON BOOSTER PUMPING STATION - MCP - VC-6 VALVE VAULT FLOOD SWITCH
D-2863		DEACON BOOSTER PUMPING STATION - MCP - TOWER ELEVATION
D-2864		DEACON BOOSTER PUMPING STATION - MCP - SURGE TANK LEVEL TRANSMITTER
DBP-67		YARD PIPING PLAN
DBP-68		PIPING PROFILES
WM-E0010	1-0601M-D-E0010-001-00D	ELECTRICAL - SYMBOLS - LEGEND
WM-E0011	1-0601M-D-E0010-001-00D	ELECTRICAL - SYMBOLS - LEGEND
WY-A0451	1-0601Y-H-A0451-001-00B	AUTOMATION / I&C - VALVE ACTUATOR FV-Y011A - LOOP DIAGRAM
WY-A0452	1-0601Y-H-A0452-001-00B	AUTOMATION / I&C - HIGH HIGH LEVEL SWITCH - LOOP DIAGRAM
WY-A0453	1-0601Y-H-A0453-001-00B	AUTOMATION / I&C - HIGH HIGH LEVEL SWITCH - LOOP DIAGRAM
WY-A0454	1-0601Y-H-A0454-001-00B	AUTOMATION / I&C - LEVEL TRANSMITTER PT-Y010B - LOOP DIAGRAM
WY-A0455	1-0601Y-H-A0455-001-00B	AUTOMATION / I&C - LEVEL TRANSMITTER PT-Y010A - LOOP DIAGRAM
WY-A0456	1-0601Y-H-A0456-001-00B	AUTOMATION / I&C - VC-305 VALVE VAULT FLOOD SWITCH - LOOP DIAGRAM

Consultant Drawing No.	City Drawing No.	Title
WY-A0457	1-0601Y-D-A0457-001-00B	AUTOMATION / I&C - PRESSURE TRANSMITTER AND IN-LINE PRESSURE SENSOR AND FLOAT SWITCH INSTALLATION DETAILS
WY-B0100	1-0601Y-A-B0100-001-00D	ARCHITECTURAL - MAIN ENTRY PLAN, INTERMIEDIATE PLAN, OVERFLOW PLAN
WY-B0300	1-0601Y-A-B0300-001-00D	ARCHITECTURAL - ELEVATIONS
WY-B0400	1-0601Y-A-B0400-001-00D	ARCHITECTURAL - PLAN & SECTION DETAILS
WY-C0100	1-0601Y-A-C0100-001-00D	CIVIL - SITE LOCATION PLAN
WY-E0110	1-0601Y-A-E0110-001-00D	ELECTRICAL - SITE PLAN, SCHEDULES AND DETAILS
WY-E0151	1-0601Y-A-E0151-001-00D	ELECTRICAL - PLANS AND DETAIL
WY-E0450	1-0601Y-A-E0450-001-00D	ELECTRICAL - LIGHTNING PROTECTION - ROOF PLAN, DETAILS AND SECTIONS
WY-P0010	1-0601Y-G-P0010-001-00D	PROCESS – SURGE TOWER - PROCESS AND INSTRUMENTATION DIAGRAM
WY-S0140	1-0601Y-A-S0140-001-00D	STRUCTURAL - GENERAL NOTES
WY-S0150	1-0601Y-A-S0150-001-00D	STRUCTURAL - PLAN AND SCHEDULES - AND DETAILS
WY-S0151	1-0601Y-A-S0151-001-00D	STRUCTURAL - INTERMEDIATE, ROOF, ROOF BEAM, AT OVERFLOW PLAN
WY-S0152	1-0601Y-A-S0152-001-00D	STRUCTURAL - PLAN, SECTION AND DETAIL
WY-S0250	1-0601Y-A-S0250-001-00D	STRUCTURAL - SECTIONS
WY-S0251	1-0601Y-A-S0251-001-00D	STRUCTURAL - DETAILS AND SECTIONS
WY-S0450	1-0601Y-A-S0450-001-00D	STRUCTURAL - PARTIAL PLAN, DETAILS AND SECTIONS
WY-S0451	1-0601Y-A-S0451-001-00D	STRUCTURAL - DETAILS
WY-S0452	1-0601Y-A-S0452-001-00D	STRUCTURAL - UNDERPINNING OF VALVE CHAMBER DRV 305
WY-S0453	1-0601Y-A-S0453-001-00D	STRUCTURAL – OUTFALL PIPE SUPPORT SHORING SECTIONS
WY-S0454	1-0601Y-A-S0454-001-00D	STRUCTURAL – OUTFALL PIPE SUPPORT AND SHORING AT NORTH END
WY-S0455	1-0601Y-A-S0455-001-00D	STRUCTURAL – OUTFALL PIPE SUPPORT AND SHORING @ SOUTH END

E1.3 The following Specifications are applicable to the Work:

Section #	Title
01300	Submittals
01400	Quality Control
01600	Material and Equipment
01730	Operation and Maintenance Manuals
02060	Demolition of Structures
02223	Excavation and Backfilling for Structures
02362	Bored Cast-in-Place Concrete Piles
02451	Pile Foundations, General
02468	Precast Concrete Piles
03100	Concrete Formwork
03200	Concrete Reinforcement
03250	Concrete Accessories
03300	Cast-in-Place Concrete
04051	Masonry Procedures

Section #	Title
04060	Masonry Mortar and Grout
04080	Masonry Reinforcement and Connectors
04090	Masonry Accessories
04220	Concrete Masonry Units
05500	Steel Fabrications
05530	Aluminum Fabrications
06100	Rough Carpentry
07210	Building Insulations
07220	Sprayed Foam Insulation Air Barrier
07400	Metal Cladding
07515	SBS Modified Bituminous Roofing
07550	EPDM Waterproof Membrane
07900	Joint Sealants
08110	Steel Doors and Frames
08520	Aluminum Windows
09870	Coating Systems for Steel Pipes
09900	Painting
11950	Cleaning and Disinfection of Structures
15200-00	Process Piping
15200-01	Data Sheet – Carbon Steel Pipe and Fittings – Large Diameter
16010	Electrical General Requirements
16015	Scope of Electrical Work
16106	Installation of Cables in Trenches and in Ducts
16111	Conduits, Conduit Fastenings and Conduit Fittings
16122	Wires and Cable 0-1000V
16131	Splitters, Junction Boxes, Pull Boxes and Cabinets
16132	Outlet Boxes, Conduit Boxes and Fittings
16141	Wiring Devices
16151	Wire and Box Connectors 0-1000V
16153	Connectors and Terminations
16160	Grounding
16191	Fastenings and Supports
16430	Distribution Panelboards
16440	Disconnect Switches – Fused and Non-Fused up to 600 V – Primary
16461	Dry Type Transformers up to 600 V Primary
16471	Panelboards – Breaker Type
16477	Moulded Case Circuit Breakers
16480	Power Surge Protectors
16500	General Provisions for Interior Lighting
16670	Lightning Protection
16870	Unit Heaters
16871	Strip Heaters
16950	Connections to Mechanical Equipment
16960	Starting of Electrical Equipment Systems
16980	Testing, Adjusting and Balancing of Electrical Equipment and Systems
17010	Instrumentation and Control General Requirements
17015	Scope of Instrumentation and Control Work
17110	Enclosures
17124	Instrumentation Cable
17211	Process Taps and Primary Elements
17212	Transmitters and Indicators
17216	Switches and Relays
17701	Instrument Specification Sheets
17701-A	Instrument Specification Sheets
17702	Instrument Loop Drawings
17704	Instrument Standard Details

E2. SOILS INVESTIGATION REPORT

E2.1 Further to GC:3.1, a copy of the geotechnical information is available on the Winnipeg Water Treatment Program – Project Site Information page at The City of Winnipeg, Corporate Finance, Materials Management Branch internet site at http://www.winnipeg.ca/matmgt/projects

E2.2 Test Hole Logs

E2.2.1 Geotechnical information has been compiled from various sources to summarize subsurface conditions within the work area. Test_Hole_Logs-Set1.pdf at the aforementioned internet site.

(a) By UMA Engineering

(i) TH's 04-01 to 04-10, 04-12 to 04-24, 04-31, and 04-33 to 04-50 (2004)

(ii) TH's 1 to 3 (1996)

(b) By Others

(i) TH A13 by KGS Group (1991)

(ii) TH's 3 to 6 by RM Hardy & Associates (1977)

(iii) TH 1 and 2 by Dyregrov Consultants (1993)

(c) The Figure attached with the Water Treatment Plant Test Pile Program in Appendix B of these Specifications illustrates the test pile locations in relation to the work area.

(d) Within the City of Winnipeg Water Treatment Plant Preliminary Design Report – Section 14 Geotechnical Investigation (2005), UMA Test Hole information is considered accurate at the locations drilled and at the time of the investigations. The inclusion of test hole data recorded by others does not represent any guarantees to the accuracy of this data.

(e) Test hole information is provided to assist in the Bidder's evaluation of subsurface conditions and the Bidder shall solely be responsible for any interpretation that they make from this information. Variations in soil conditions may exist between test holes and fluctuations in groundwater levels can be expected seasonally and may occur as a result of construction activities or operation of the Floodway.

E2.3 Test Pile Driving Records

E2.3.1 Test_Pile_Driving_Records-Set1.pdf at the internet site identified in E2.1 shows data recorded by UMA Engineering Ltd. during driving of ten (10) test piles at the site in March, 2005.

E2.4 Reports

E2.4.1 Additional reports and geotechnical information listed as follows are available for viewing at the offices of Earth Tech Canada Inc., 850 Pembina Highway, Winnipeg, Manitoba.

(a) The City of Winnipeg Water Treatment Plant Preliminary Design Report – Section 14 Geotechnical Investigation (2005)

(b) Water Impounding Reservoir - Cell #2 and Booster Pumping Station Deacon Manitoba by RM Hardy & Associates Ltd. (1977)

(c) Proposed Venturi Chambers Deacon Reservoir by Dyregrov Consultants (1993)

(d) Deacon Reservoir Expansion Proposed Groundwater Monitoring Program by KGS Group (1993)

(e) Shoal Lake Aqueduct Program 5 – Deacon Drainage Improvements by UMA Engineering Ltd. (1996)

(f) Pile Driving records from Deacon Booster Pumping Station by RM Hardy and Associates (1979).

(g) Pile Driving records for the Clearwell construction Bid Opportunity 166-2005 by Earth Tech (Canada) Inc. (2005).

Information in these reports has been provided to assist in the Bidder's evaluation of subsurface conditions and the Bidder shall solely be responsible for any interpretation that they make from this information.

GENERAL REQUIREMENTS

E3. OFFICE AND SITE FACILITIES

E3.1 The Contractor shall supply office facilities for his own use. The facilities shall be situated between the excavation and the fence south of the work site.

E3.2 With reference to drawing CM-G001, the City will provide to the Contractor without cost:

(a) Communications connections for four telephone and internet (high speed equivalent). The Contractor shall supply and install the telephone service from the City's existing telephone service pedestal that is located south of the fence and east of the compound access road.

(b) Onsite washroom and toilet facilities with non-potable water supply, and

(c) Power for construction purposes, the City will allow connection to and use of the temporary service that serviced the existing trailer that was relocated. The Contractor shall protect the temporary services until the existing trailer is relocated back to its current location.

(d) Unless otherwise specified, all required over-current protection, portable distribution panels and transformations, cables, conductors, grounding and other materials required to provide construction power for the Work shall be supplied and installed by the Contractor.

(e) Granular pad south of the road for laydown, storage and parking. The Contractor shall provide security fencing as required to secure the storage area. The granular pad is provided for the shared use by this Contract and the future yard piping contract.

E3.3 The Contractor may arrange for additional facilities with the approval of the Contract Administrator and at the Contractor's cost.

E4. SITE ROADS AND WORK SITE ACCESS

E4.1 The Contractor shall have access to the Site on Business Days between 07:00 and 18:00 unless otherwise approved by the Contract Administrator.

E4.2 Access to the work site is restricted and cooperation with other contractors on site is necessary in the best interest of all parties.

E4.3 The Site is located on Provincial Road 207, 3.2 km north of Highway 1 in Dugald, Manitoba.

E4.3.1 The Site address is PR 207, Lot 57082, Dugald, Manitoba.

E4.3.2 Provincial Road 207 is a Class B1 road and is subject to load restrictions which will affect the maximum weight of individual deliveries. However, The City of Winnipeg and Manitoba Transportation and Government Services (TGS) have reached the following agreement to facilitate construction of the Winnipeg Water Treatment Program:

(b) The approximately 3.2 km of PR 207 between the entrance to the Site and Highway 1 will be designated as an TAC Route for construction of the Winnipeg Water Treatment Program effective January 1, 2006 until TGS imposes Spring Restrictions.

(c) During the TGS imposed Spring Restriction period, normal (non Spring Restriction) Class B1 highway loadings will be allowed on PR 207 between the entrance to the Site and Highway 1. The Spring Restriction period is normally in place from March 23 to May 26, but it is subject to change due to weather conditions as assessed by

TGS. Upon removal of the Spring Restriction, normal Class B1 will continue to be allowed.

(d) The portion of PR 207 between the entrance to the Site and Highway 1 will be upgraded during 2006 to a TAC Route. PR 207 will remain open during the upgrading process but users will be subjected to intermittent delays due to road construction.

(e) TGS permits will be required for each construction vehicle in excess of Class BI highway loading from January 1, 2006 until the upgrade of PR 207 has been completed:

(i) The Contract Administrator will provide permit forms to the Contractor.

(ii) The Contractor shall complete a permit form for each company retained to transport materials to the Site and shall return them to the Contract Administrator who will submit the permit forms to TGS for processing.

(iii) The Contract Administrator will return the completed permit forms to the Contractor and the Contractor shall ensure that each vehicle carries a photocopy of the permit.

(iv) The permit fee will be paid directly to TGS by the City of Winnipeg. The Contractor will not be charged for the permit fees.

(v) The permit will be good for 1 year from issue.

(vi) The Contract Administrator will establish a process to record the date, company name and commodity of each vehicle entering the Site.

(vii) TGS will make random permit checks of vehicles using PR 207.

E4.4 Construction and removal, if necessary, of any temporary access roads required to perform the Work is the responsibility of the Contractor.

E5. FIELD ENGINEERING

E5.1 The Contractor shall engage a qualified surveyor to layout the works and record as-constructed measurements for Record Drawings.

E5.2 The surveyor shall be a registered Manitoba Land Surveyor, or an instrumentman or surveying firm experienced in layout of similar projects, subject to the approval of the Contract Administrator.

E5.3 Survey reference points for horizontal and vertical control are indicated on the drawings. The Contractor shall locate, confirm and preserve the reference points during construction.

E6. SITE DRAINAGE

E6.1 The Contractor shall be responsible for drainage of all excavations associated with the Work from Award until Total Performance.

E6.2 Provision of adequate site drainage during the performance of the Contract shall be the Contractor's responsibility. The Contractor shall maintain site grading as necessary to provide for proper drainage away from the excavated areas. This water is to be re-directed into ditches outside of the site. Silt fences shall be properly erected and keyed into the primary ditches to prevent eroded materials from leaving the site. No extra payment or time extension will be granted as a result of difficulties associated with site access resulting from poor site drainage during any part of the performance of the Work.

E7. WASTE CONTAINER

E7.1 A waste container to dispose of garbage produced from the site shall be provided by the Contractor. It shall be located in a safe, convenient location, and be emptied as necessary by the Contractor. The provision, maintenance and removal of a waste container shall be considered a subsidiary obligation of the Contractor.

E8. SANITATION FACILITY

E8.1 Portable toilets may be provided by the Contractor. Any portable toilet shall be cleaned on a weekly basis and provided with regular maintenance as required to ensure proper operation.

E8.2 Portable toilets shall be located in an area acceptable to the Contract Administrator.

E9. CONDITION, PROTECTION OF, AND ACCESS TO THE AQUEDUCT

E9.1 Condition of the Aqueduct

E9.1.1 The Aqueduct is constructed of reinforced concrete and in some areas, contains numerous cracks. The Aqueduct, therefore, shall be considered as a fragile structure. All work procedures conducted by the Contractor on and/or near the Aqueduct shall be well planned and executed to ensure that the Aqueduct is not subjected to construction related loads, including excessive vibrations and concentrated or asymmetrical lateral loads.

E9.2 Protection of the Aqueduct

E9.2.1 Contractors working in the vicinity of the aqueduct shall ensure that:

(a) Equipment shall only be permitted to cross the Aqueduct at designated bridge crossing locations and shall come to a complete stop before crossing.

(b) Granular material, construction material, soil or other material shall not be stockpiled on the Aqueduct or within 10 metres of the Aqueduct centreline.

(c) Construction practices shall not subject the Aqueduct arch to asymmetrical loading at any time.

(d) Construction practices or procedures at or near the Aqueduct shall not impart excessive vibration loads on the Aqueduct and/or cause settlement of the subgrade below the Aqueduct.

E9.2.2 It is the Contractors' responsibility to ensure that all work crew members understand, observe, and work to the requirements of Specifications.

E9.3 Equipment Restrictions

E9.3.1 Equipment must cross the Aqueduct in a responsible and careful manner (i.e. slowly).

E10. ENVIRONMENTAL PROTECTION

E10.1 The Contractor shall be aware that the Aqueduct is for potable water supply and no contamination by fuel, chemicals, etc. shall be permitted at any time. Fuels or chemicals shall not be stored within 30 metres of the Aqueduct.

E10.2 The Contractor shall plan and implement the Work of this Contract strictly in accordance with the requirements of the environmental protection measures as herein specified.

E10.3 The Contractor is advised that at least the following Acts, Regulations, and By-laws apply to the Work:

E10.3.1 Federal

(a) Canadian Environmental Protection Act (CEPA) c.16

(b) Transportation of Dangerous Goods Act and Regulations c.34

E10.3.2 Provincial

(a) The Dangerous Goods Handling and Transportation Act D12

(b) The Endangered Species Act E111

(c) The Environment Act c.E125

(d) The Fire Prevention Act F80

(e) The Manitoba Nuisance Act N120

(f) The Public Health Act c.P210

(g) The Workplace Safety and Health Act W120

(h) Current applicable associated regulations.

(i) The Fisheries Act

(j) The Migratory Birds Act

(k) The Historic Resources Act

(l) Drinking Water Safety Act

E10.3.3 The Contractor is advised that the following environmental protection measures apply to the Work.

E10.3.4 Materials Handling and Storage

(a) Construction materials shall not be stored within ten (10) metres of the Aqueduct centerline without the approval of the Contract Administrator.

E10.3.5 Fuel Handling and Storage

(a) The Contractor shall abide by the requirements of Manitoba Conservation storage and handling of Petroleum Products and Allied Products Regulations for handling and storage of fuel products.

(b) All fuel handling and storage facilities shall comply with The Dangerous Goods and Transportation Act Storage and Handling of Petroleum Products Regulation and any local land use permits.

(c) Fuels, lubricants, and other potentially hazardous materials as defined in The Dangerous Goods and Transportation Act shall be stored and handled within the approved storage areas.

(d) The Contractor shall ensure that all fuel storage containers are inspected daily for leaks and spillage.

(e) Products transferred from the fuel storage area(s) to specific work sites shall not exceed the daily usage requirement.

(f) When servicing requires the drainage or pumping of fuels, lubricating oils or other fluids from equipment, a groundsheet of suitable material (such as HDPE) and size shall be spread on the ground to catch the fluid in the event of a leak or spill. No repairs within 30 m of aqueduct or watercourse will be permitted.

(g) Refuelling of mobile equipment and vehicles shall take place at least 30 m from a watercourse.

(h) The area around storage sites and fuel lines shall be distinctly marked and kept clear of snow and debris to allow for routine inspection and leak detection.

(i) A sufficient supply of materials, such as absorbent material and plastic oil booms, to clean up minor spills shall be stored nearby on-site. The Contractor shall ensure that

additional material can be made available on short notice. All refuelling vehicles shall be equipped with a spill response kit.

E10.3.6 Waste Handling and Disposal

(a) The construction area shall be kept clean and orderly at all times during and at completion of construction.

(b) At no time during construction shall personal or construction waste be permitted to accumulate for more than one day at any location on the construction site, other than at a dedicated storage area as may be approved by the Contract Administrator.

(c) Indiscriminate dumping, littering, or abandonment shall not take place.

(d) No on-site burning of waste is permitted.

(e) Equipment shall not be cleaned within 30 m of watercourses; contaminated water from onshore cleaning operations shall not be permitted to enter watercourses.

E10.3.7 Dangerous Goods/Hazardous Waste Handling and Disposal

(a) Dangerous goods/hazardous waste are identified by, and shall be handled according to, The Dangerous Goods Handling and Transportation Act and Regulations.

(b) The Contractor shall be familiar with The Dangerous Goods Handling and Transportation Act and Regulations and meet training requirements for these Regulations.

E10.3.8 Emergency Spill Response

(a) The Contractor shall ensure that due care and caution is taken to prevent spills.

(b) The Contractor shall report all major spills of petroleum products or other hazardous substances with the potential for impacting the environment and threat to human health and safety to the Contract Administrator and Manitoba Conservation, immediately after occurrence of the environmental accident, by calling the 24-hour emergency telephone phone number (204) 945-4888.

(c) The Contractor shall designate a qualified supervisor as the on-site emergency response coordinator for the project. The emergency response coordinator shall have the authority to redirect manpower in order to respond in the event of a spill. (Should include reference to a site-specific Emergency Response Plan and Environmental Protection Plan.)

(d) The following actions shall be taken by the person in charge of the spilled material or the first person(s) arriving at the scene of a hazardous material accident or the on-site emergency response coordinator:

(i) Notify emergency-response coordinator of the accident:

identify exact location and time of accident

indicate injuries, if any

request assistance as required by magnitude of accident Manitoba Conservation 24-hour Spill Response Line (204) 945-4888, RCMP (Oakbank Detachment) (911), City of Winnipeg Fire Department (911), Springfield Ambulance (911), company backup, contact Contract Administrator.

(ii) Assess situation and gather information on the status of the situation, noting:

personnel on site

cause and effect of spill

estimated extent of damage

amount and type of material involved

proximity to waterways and the Aqueduct

(iii) If safe to do so, try to stop the dispersion or flow of spill material:

approach from upwind

stop or reduce leak if safe to do so

dyke spill material with dry, inert sorbent material or dry clay soil or sand

prevent spill material from entering waterways and utilities by dyking

prevent spill material from entering Aqueduct manholes and other openings by covering with rubber spill mats or dyking

(iv) Resume any effective action to contain, clean up, or stop the flow of the spilled product.

The emergency response coordinator shall ensure that all environmental accidents involving contaminants shall be documented and reported to the Manitoba Conservation according to The Dangerous Goods Handling and Transportation Act Environmental Accident Report Regulation 439/87.

E11. SITE RESTORATION

E11.1 The Contractor shall remove the temporary Site office and storage facilities prior to Total Performance being issued.

E11.2 The Contractor shall be responsible for ground restoration, as determined necessary by the Contract Administrator. The Contractor shall restore all disturbed previously grassed areas with sod in accordance with CW 3510.

E11.3 The Contractor shall be responsible for any damage caused by his forces on roadways or accesses.

E12. RECORD DRAWINGS

E12.1 The Contractor shall keep one (1) complete set of white prints at their Site office, including all Addenda, Change Orders, Field Instructions, and other revisions for the purposes of Record Drawings. As the Work proceeds, the Contractor shall clearly record in red pencil all as-built conditions which deviate from the original Contract documents.

E12.2 The Record Drawings shall be available for review by the Contract Administrator upon request at any time during the performance of the Work.

E12.3 Prior to achieving Total Performance, the Contractor shall submit the Record Drawings prepared to the Contract Administrator for his review and use. If, in the opinion of the Contract Administrator, the Record Drawings are incomplete or inaccurate, the Record Drawings will be returned to the Contractor and the Contractor shall revise and resubmit the Record Drawings at the Contractor's cost.

E12.4 Total Performance cannot be achieved without the submission of Record Drawings as specified in this article and that are acceptable to the Contract Administrator.

E13. GROUNDWATER CONTROL

E13.1 The Contractor is advised that operation of the Red River Floodway may cause high groundwater pressures in the till layer underlaying the area of Work activities. The levels of the till induced groundwater pressures in the soil at the site are similar to the water levels in the floodway. The Contract Administrator will monitor groundwater levels at the site.

E13.2 On reaching elevation 231.0, rising groundwater pressures may begin to affect the bottom of the open excavation (elevation 229.85) and cause base heave. Base heave is the condition where the groundwater pressures from the underlaying till will cause the soil at the bottom of

the excavation to lift. The elevation at which base heave may occur will rise as components of the structure are constructed and dewatering is not required once the structure is backfilled.

E13.3 A till groundwater dewatering system has been installed on the site and consists of two wells complete with pumps, control panels and discharge hoses. The pumps can be operated singly or together to lower the till induced groundwater pressures. Generally, it has only been necessary to operate the west well to control the groundwater pressures. The control panels are equipped with strobe lights and horns which will annunciate a pump operation failure.

E13.4 Should the till induced groundwater levels raise to elevation 231.0 due to the operation of the floodway, the Contractor shall operate and maintain the dewatering system to lower the groundwater pressures to elevation 229.0. The Contract Administrator will instruct the Contractor on the operation of the dewatering system. The dewatering system requires monitoring 24 hours per day every day while in operation in case of an electrical or pump failure. A copy of the operating protocol for the dewatering system will be made available to the bidders for review.

E13.5 Should the design for the shoring system installed by the Contractor require dewatering, the Contractor will be permitted to use, operate and maintain the existing dewatering system to lower the groundwater pressures.

E14. EXISTING SITE OFFICE RELOCATION & GRAVEL PARKING AREAS

E14.1 Relocate the existing site office from the current location at the site of the new surge tower to the new location adjacent to the fence as shown on drawing CM G003. Re-install anchors, blocking and skirting around the base of the office.

E14.2 Provide a 30 mm temporary water service to the site office cw heat trace and insulation (match existing), hook the temporary water line to the 30 mm temporary water line that is currently feed out of the east side of the water building. Provide a 100 amp 120/208V single phase service (Teck cable) from the existing electrical panel in the water building to the existing panel in the site office. Bury the temporary water service cw 75 sand bedding in a 300 mm deep trench located adjacent to the fence. Bury the electrical service between the water building and the fence east of the water building, run the remainder of the service cable above grade along, and fastened to, the fence.

E14.3 Supply and install a temporary septic tank (approximate1100 gallon capacity) cw piping hooked up to the plumbing under the site office. The piping shall be heat traced and insulated. Locate the tank adjacent to and south of the chain link fence. The temporary septic tank, complete with high level alarm system, shall be double walled construction and buried in the ground, or if a tank with single wall construction is used, it shall be installed with a synthetic liner and a 200 mm layer of pea gravel under and all around the tank. A 200 mm diameter perforated pipe shall be installed full depth in the pea grave for detection of any potential leakage from the tank.

E14.4 Excavate all cross hatched areas to a depth of 200 mm. Supply and install 150 mm compacted thickness of 50 mm down limestone and 50 mm compacted thickness of 20 mm down limestone.

E14.5 Supply and install two outdoor/weatherproof duplex receptacles (2 circuits, 15 amp, 120V) evenly spaced along the chain link fence at the parking area (locate on 2x6 fastened to fence at 800 mm above grade, run Teck cable above grade fastened to fence).

E14.6 Supply & install a man gate in the existing south fence approximately 6 metres west of the south east corner of the fence.

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 all submissions with a transmittal letter, in duplicate, containing:

.1 Date

.2 Project title and Bid Opportunity number

.3 Contractor's name and address

.4 Specification Section number for each submittal

.5 Submittal number and revision number in the following format:

.1 37 - Spec Section # - Submittal # - Revision # (e.g. 37-05500-001-1).

.2 The first submittal is numbered 1 with sequential numbering after that for revisions.

.6 Identification and quantity of each Shop Drawing product

.7 Equipment tag number

.8 Other pertinent data

.3 Submissions shall include:

.1 Date and revision dates

.2 Project title and number

.3 Name, email address, 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 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 twelve (12) 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 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 twelve (12) copies of product data.

.3 Sheet size: 215 x 280 mm.

1.6 Procedure and Routing

.1 The Contractor shall provide to the Contract Administrator thirteen (13) printed copies of the Shop Drawings and corresponding submittal transmittal form(s) complete with the information specified in 1.3 Submission Requirements.

.2 The Contractor shall simultaneously email the .pdf version of these same Shop Drawings and submittal transmittal forms to the Contract Administrator. The Contractor shall ensure the .pdf version of the Shop Drawings and corresponding submittal transmittal form(s) are identical to the printed copies being distributed for review. When the total size of the email is greater than 5 MB, the Contractor shall post the .pdf version of the Shop Drawings and submittal transmittal form(s) to an accessible place on the internet (provided by the Contract Administrator) and an e-mail notification is to be sent to all parties listed above when posting is complete.

.3 The routing and the names of individuals responsible for receiving submittals will be identified by the Contract Administrator at the pre-construction meeting held pursuant to D4.2.

.4 Upon review of the Shop Drawings, the Contract Administrator will e-mail the .pdf version of the annotated Shop Drawings and corresponding transmittal form(s) to the Contractor. When the total size of the email is greater than 5 MB, the Contract Administrator will post the .pdf version of the Shop Drawings and corresponding transmittal form(s) to the same accessible place on the internet and an e-mail notification will be sent to the Contractor. Two (2) printed copies of the reviewed Shop Drawings will be sent back to the Contractor.

SUBMITTALS

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 – Operations and Maintenance Manuals.

END OF SECTION

QUALITY CONTROL

1. CODES AND STANDARDS

.1 In the case of a conflict or discrepancy between the Contract Documents and the governing standards, the more stringent requirements shall apply.

.2 Unless the edition number and date are specified, the reference to the Manufacturer's and published codes, standards, and Specifications are to be the latest edition published by the issuing authority, current at the date of Submission Deadline.

.3 Reference standards and Specifications are quoted in this Specification to establish minimum standards. Work in quality exceeding these minimum standards conforms to the Contract.

.4 Where reference is made to a Manufacturer's direction, instruction, or Specification, it is deemed to include full information on storing, handling, preparing, mixing, installing, erecting, applying, or other matters concerning the products pertinent to their use and their relationship to the products with which they are incorporated.

.5 Confine apparatus, the storage of products, and the operations of workers to limits indicated by laws, ordinances, permits, and by directions of the Contract Administrator. Do not unreasonably encumber the premises with products.

.6 Where reference is made to regulatory authorities, it includes all authorities who have, within their constituted powers, the right to enforce the laws of the Place of Work.

2. TESTING AND QUALITY CONTROL

.1 Provide to the Contract Administrator, 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 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

MATERIAL AND EQUIPMENT

1. PRODUCTS

1.1 Manufacturers' Directions

.1 Unless otherwise specified, install or erect all products in accordance with Manufacturers' recommendations. Do not rely on labels or enclosures provided with products. Obtain instructions directly from manufacturers.

.2 Notify the Contract Administrator, in writing, of any conflicts between the Specifications and Manufacturers' instructions so that the Contract Administrator may establish the course of action.

.3 Improper installation or erection of products due to failure in complying with these requirements authorizes the Contract Administrator to require any removal and re-installation that may be considered necessary, at no increase in Contract Price.

2. WORKMANSHIP

2.1 Concealment

.1 In finished areas conceal all pipes, ducts and wiring except where indicated otherwise on Drawings or in Specifications.

.2 Before installation inform the Contract Administrator if there is a contradictory situation.

2.2 Location of Fixtures

.1 Consider the location of fixtures, outlets, and other mechanical and electrical items indicated on Drawings as approximate. The actual location of these items is to be as required or directed to site conditions at the time of installation and as is reasonable.

.2 Before installation inform the Contract Administrator if there is a contradictory situation. Install as directed.

2.3 Cutting and Remedial Work

.1 Perform all cutting and remedial work that may be required to make the several parts of the Work come together properly. Coordinate and schedule the Work to ensure that cutting and remedial work are kept to a minimum.

.2 Employ specialists familiar with the materials affected in performing cutting and remedial work. Perform in a manner to neither damage nor endanger any portion of the Work.

.3 Do not cut, drill or sleeve any load-bearing members without written acceptance of the Contract Administrator.

.4 The Contractor is to perform work so as to minimize dust.

2.4 Fastenings

.1 Provide metal fastenings and accessories in same texture, colour and finish as adjacent material unless otherwise specified.

.2 Prevent electrolytic action between dissimilar metals and materials.

.3 Use non-corrosive, non-staining fasteners and anchors for securing exterior Work unless otherwise specified.

.4 Space anchors within their load limit or shear capacity and ensure that they provide positive permanent anchorage. Wood plugs are not acceptable.

.5 Keep exposed fastenings to a minimum, space evenly and lay out neatly.

.6 Fastenings which cause spalling or cracking of material to which anchorage is made are not acceptable.

3. MEASUREMENT

3.1 Metric Project

.1 Unless otherwise noted, this Project has been designed and is to be constructed in the SI nominal metric system of measurements.

END OF SECTION

OPERATION AND MAINTENANCE MANUALS

1. DESCRIPTION

.1 This Section supplements the requirements for the provision of O&M Manuals as described in Section 01300 – Submittals.

.2 Furnish complete operations manuals and maintenance information as specified in this Section for installation, check-out, operation, maintenance, and lubrication requirements for each unit of mechanical, electrical, and instrumentation equipment or system and each instrument.

.3 Customize the operations manuals and maintenance information to describe the equipment actually furnished. Do not include extraneous data for models, options, or sizes not furnished (cross out or remove if required). When more than one model or size of equipment type is furnished, show the information pertaining to each model, option, or size.

.4 Assemble, coordinate, bind, and index required data into an O&M Manual.

.5 Three (3) draft copies of the manuals shall be submitted a minimum of sixty (60) days prior to Substantial Performance of the Work for review and comments. A maximum of eight (8) weeks after review, twelve (12) copies of the final manuals shall be supplied.

.6 In addition to the twelve (12) hard copies, submit an electronic version of the O&M Manual.

.7 Materials: Label each Section with tabs protected with celluloid covers, fastened to hard paper dividing sheets.

.8 Type lists and notes.

.9 Drawings, diagrams and Manufacturer's literature must be legible. Drawings larger than 280 x 430 mm must be folded and placed inside plastic pockets.

2. OPERATION AND MAINTENANCE MANUAL CONTENTS AND ORGANIZATION

.1 Provide the Manufacturer’s standard O&M manuals for the equipment or instruments supplied. If the Manufacturer's standard manuals do not contain all the required information, provide the missing information in supplementary documents and Drawings inserted behind appropriate tabs in the manual binder.

.2 When more than one (1) piece of identical equipment or instruments are supplied, provide only one (1) set of operations manuals.

.3 One (1) set of operations manuals may be provided when more than one (1) piece of similar equipment or instruments are supplied, such as different sizes of the same model, and all similar pieces are covered in the same standard Manufacturer's O&M manual.

.4 When similar equipment or instruments are provided by the same Manufacturer, but are not covered in the same standard Manufacturer's O&M manual, their specific manuals may be

bound in the same 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 "".

3. FIELD CHANGES NOT APPLICABLE

.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 3-ring binders for 215 x 280 mm paper labelled "COMMISSIONING DATA" one (1) copy of:

.1 All completed equipment testing and commissioning forms.

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

.3 All system performance reports.

5. WARRANTIES

.1 Provide in hard cover 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

DEMOLITION OF STRUCTURES

1. GENERAL

1.1 Work Included

.1 Demolition and disposal of all materials removed from the existing pipe within the newly constructed structure to the extents indicated on the Drawings.

1.2 References

.1 CSA S350, Code of Practice for Safety in Demolition of Structures.

1.3 Protection

.1 Take precautions to not damage any portions of the structure during demolition operations.

.2 Prevent debris from blocking surface drainage systems and mechanical and electrical systems which must remain in operation.

2. PRODUCTS

2.1 Materials

.1 Except where noted otherwise, maintain possession of all materials being demolished and immediately remove from Site.

3. EXECUTION

3.1 Demolition

.1 Demolish parts of the existing outfall pipe to the extent indicated on the Drawings.

.2 Obtain Contract Administrator's acceptance prior to use of vibratory equipment on existing structures.

.3 Remove existing obstacles if required for refinishing or making good of existing surfaces, and replace as work progresses.

.4 At end of each day's work, leave work in safe condition so that no part is in danger of toppling or falling. Protect parts not to be demolished from damage at all times.

.5 Carry out demolition operation in a manner to minimize dusting, keeping materials wetted as required.

.6 Remove and properly dispose of demolished materials off Site and in accordance with authorities having jurisdiction.

END OF SECTION

EXCAVATION AND BACKFILLING FOR STRUCTURES

1. GENERAL

1.1 Work Included

.1 Work under this Section includes, but is not necessarily limited to the following items:

.1 Excavation to required elevations for the void form and base slab

.2 Excavation required for underpinning of existing Valve Chamber DRV 305

.3 Disposal of surplus excavated material

.4 Dewatering of excavation.

1.2 Reference Standards

.1 Conform to requirements of the NBC and the Canadian Construction Safety Code.

.2 Comply with excavation and trenching regulations of Provincial authorities.

1.3 Samples

.1 All materials incorporated into the Work of this Specification shall be subject to review and testing by the Contract Administrator, including all operations from the selection and separation of the materials, through to final acceptance of the specified Work.

.2 The Contractor shall be wholly responsible for the control of all operations incidental to the Work, notwithstanding any review or acceptance that may have previously been given.

.3 The Contract Administrator reserves the right to reject any materials or works which are not in accordance with the requirements of this Specification.

.4 There shall be no charge for any materials taken by the Contract Administrator for testing purposes.

.5 All materials shall be reviewed and accepted by the Contract Administrator at least ten (10) days before any construction is undertaken.

.6 For granular materials, submit a 25 kg sample for coarse, gravelly soil, or 75 kg sample for coarse, crushed stone and sand of each type, clearly labelled for type and source of the materials, for analysis by testing laboratory. Ship samples prepaid or deliver in tightly closed containers to testing laboratory designated by Contract Administrator.

.7 Costs for analysis will be paid by the City.

1.4 Compaction Testing

.1 Testing of compacted fill materials will be performed by an independent inspection and testing firm appointed and paid by the City. Testing will be performed so as to least encumber the performance of the Work.

.2 The City will pay for the first series of tests only, on the area being evaluated. Pay costs for additional testing, if required, due to improper performance of Work.

.3 Tests will be performed in accordance with ASTM D698 for Standard Proctor Density on representative samples to control compaction requirements. The Contract Administrator will decide the frequency and number of tests required.

.4 The field density of the compacted layers shall be verified by field density tests in accordance with ASTM D2922, using nuclear methods performed by the inspection and testing firm. The frequency and number of tests required will be decided by the Contract Administrator.

.5 Notify the Contract Administrator when Work of this Section or portions of Work are completed to own satisfaction. Do not proceed with additional portions of Work until test results have been verified and accepted.

.6 During Work tests, if tests indicate that compacted materials do not meet specified required materials, remove defective Work, replace and re-test at own expense as directed by the Contract Administrator.

.7 Ensure compacted fills are tested and accepted before proceeding with placement of surface materials.

2. PRODUCTS

2.1 General

.1 All materials to be subject to Contract Administrator's acceptance.

.2 Granular materials to be composed of sound, hard, uncoated particles, free from injurious quantities of clay, flaky particles, soft shale, friable materials, roots, vegetable matter, and frozen lumps.

.3 Grading of granular materials to show no marked fluctuations between opposite ends of extreme limits.

.1 Type 1: pit run granular backfill shall consist of a clean, well-graded, and free-draining pit run material with a maximum size of 75 mm, and less than 5% by weight finer than 0.075 mm.

.2 Type 2: crushed gravel graded within following limits:

Canadian Metric Sieve Size	Percent Passing	
	Crushed Granular	Crushed Limestone
25,000	100	-
20,000	80 - 100	100
5,000	40 - 70	40 – 70
2,500	25 - 55	25 – 60
315	13 - 30	8 – 25
80	5 - 15	6 – 17

At least 60% of material retained on 5 mm sieve to have at least one (1) freshly fractured face.

.4 Type 3: pit run sand for levelling with maximum stone size 40 mm.

.5 Type 4: common backfill shall be free from organic material and rocks larger than 150 mm in size and building debris. Fill under landscaped areas to be free from alkali, salt, petroleum products and other materials detrimental to plant growth. Common backfill shall be obtained from Disposal Site 2 as directed by the Contract Administrator.

.6 Type 5: cement-stabilized fill shall be supplied in accordance with CW2030 – Excavation Bedding and Backfill.

3. EXECUTION

3.1 General

.1 Familiarization

.1 Prior to all work of this Section, become thoroughly familiar with the Site, the Site conditions, and all portions of the work falling within this Section.

.2 Review and understand the geotechnical information.

.3 Review and understand the Construction Sequence presented on the Drawings.

.2 Protection

.1 Before starting Work, locate all utilities crossing the Work Site. Notify all agencies or companies having jurisdiction over the specific utilities and protect, relocate, remove, or discontinue service according to their requirements. Any damages shall be repaired at the Contractor's expense.

.2 Protect and restore pavements, boulevards, grassed areas, etc., that may be opened or damaged in the performance of the Work.

.3 During construction, maintain roadways in a clean and safe condition and, at the completion of the Contract, clean and restore all roads used to perform the Contract.

3.2 Finish Elevations and Lines

.1 For setting and establishing finish elevations and lines, secure the services of a registered surveyor or experienced instrumentman acceptable to the Contract Administrator.

.2 Carefully preserve all data and all monuments set by the registered surveyor. If displaced or lost, immediately replace to the acceptance of the Contract Administrator, at no additional cost to the City.

3.3 Excavation

.1 Three (3) weeks prior to commencement of the Work, submit an excavation plan sealed and signed by a qualified Professional Engineer registered in the Province of Manitoba to the Contract Administrator for review. No excavation Work shall proceed and no claim for delay will be allowed, until the excavation plan has been reviewed and accepted by the Contract Administrator.

.2 Perform excavation in strict compliance to Workplace Safety and Health and authorities having jurisdiction.

.3 Excavate to noted limits and as required for the Work of this Contract. Stockpile material to be used for backfilling On-Site as directed by the Contract Administrator. Excess material is to be disposed of immediately to west of Disposal Site 2 as directed by the Contract Administrator.

.4 When complete, request Contract Administrator to review excavations.

.5 Local pockets of material which, in the opinion of the Contract Administrator are unsuitable, shall be removed to such depths as required by the Contract Administrator.

.6 The completed excavation shall provide clean, level, solid, and water-free surfaces at the required elevations, ready to receive construction.

.7 Excavations are not to encroach on existing slopes and as indicated in the geotechnical information.

.8 Make good all damage occurring as a result of inadequate, unauthorized, or defective methods of protection.

.9 Areas used for temporary stockpiling shall be restored to existing condition or better.

3.4 Shoring

.1 Design, supply, and install all shoring as required to prevent damage or undermining of the existing and new structures, excavations, and injury to personnel.

.2 Three (3) weeks prior to commencement of the Work submit Drawings and calculations sealed and signed by a qualified Professional Engineer registered in the Province of Manitoba for all shoring used for the construction of this project. No shoring installation

shall proceed and no claim for delay will be allowed, until the shoring plan has been reviewed and accepted by the Contract Administrator.

.3 Comply with all applicable rules and regulations of governmental authorities.

.4 Erect shoring and bracing independent of utilities and structures.

.5 Prefabricated cages or shields may be used to supplement or replace conventional shoring, provided they comply with all applicable safety regulations.

.6 Assume full responsibility for any failure, collapse, or movement of existing structures, shoring and bracing, earth banks, trenches, and other excavations.

3.5 Backfilling, Fill, and Compaction

.1 Preparation

.1 Ensure areas to be backfilled are free from debris, snow, ice, and water; and that ground surfaces are not in a frozen condition.

.2 Backfilling and Filling

.1 Backfill and fill to grades, contours, levels, and elevations as directed by the Contract Administrator.

.2 Maintain optimum moisture content of materials to permit compaction to specified densities.

.3 Compact each soil layer to at least the specified minimum degree; repeat compaction process until plan grade is attained. Compaction densities indicated herein are based on ASTM D698 for Standard Proctor Density.

.4 Fill for Over-Excavation: backfill over-excavation with Type 1 pit run gravel placed in uniform lifts not greater than 200 mm in thickness and compact to a density of at least 95% Standard Proctor Density at no additional cost to the City.

.5 Fill 1500 mm around Structure: backfill around structures with Type 1 pit run granular placed in uniform lifts not greater than 200 mm in thickness and compact to a density of at least 95% Standard Proctor Density.

.6 General Fill: backfill with Type 4 common fill placed in uniform lifts not greater than 300 mm in thickness and compact to a density of at least 95% Standard Proctor Density.

.7 Slab on Grade Base Course: Type 2 fill under concrete slabs on grade shall be placed in uniform lifts not greater than 150 mm in thickness and shall be compacted to a density of at least 100 % Standard Proctor Density.

.8 Between Pipe and Concrete Base: bedding sand Type 3.

.9 Fill under Pipe: backfill under pipes with cement-stabilized fill in accordance with CW2030 – Excavation Bedding and Backfill.

3.6 Disposal

.1 Surplus material not required for backfill and fill purposes shall be disposed of On-Site to a location designated by the Contract Administrator at no extra cost to the City.

3.7 Clean-Up

.1 As excavation proceeds, keep roads, streets, and sidewalks clean of dirt and excavated material.

.2 Clean-up and wash down to remove all dirt and excavated materials caused by Work of this Section.

.3 Clean at the end of each working day as directed by the Contract Administrator.

END OF SECTION

BORED CAST-IN-PLACE CONCRETE PILES

1. GENERAL

1.1 Work Included

.1 Excavate and grade for equipment support at pile locations

.2 Machine drill underpinning pile shafts for the existing Valve Chamber DRV 305

.3 Dewatering

.4 Place concrete and reinforcement and prepare piles for capping

.5 Remove all excavated materials and deposit on site where directed by Contract Administrator

1.2 Quality Assurance

.1 Construct cast-in-place concrete piles in accordance with CAN/CSA-A23.1-00.

1.3 Qualifications

.1 If required by Contract Administrator, produce satisfactory proof of successful installation experience with this type of foundation, in similar conditions and with piles of similar capacities.

1.4 Pile Design

.1 Reinforced cast-in-place concrete type for underpinning function.

.2 Pile shaft adhesion values used for design calculations is 14.4 kPa.

1.5 Shop Drawings

.1 Submit detailed shop drawings for review in accordance with Section 01300 – Submittals.

.2 Clearly identify pile lengths, diameters, reinforcement, steel casings, drilling, and concrete placement techniques, sequence, and related scheduling.

1.6 Inspection and Testing

.1 Submit concrete mix designs as per Section 03300 – Cast-in-Place Concrete.

.2 Inspection and testing of concrete will be conducted as per Section 03300 – Cast-in-Place Concrete.

.3 Provide free access to all portions of work and cooperate with inspection and testing personnel.

.4 Inspection and testing firm engaged by the City will inspect shaft prior to placement of concrete or reinforcement. Cooperate and schedule inspection visits.

1.7 Field Records

.1 Contractor shall cooperate with the Contract Administrator and shall allow access during the pile installation operations so that all the field measurements can be performed expeditiously.

2. PRODUCTS

2.1 Materials

.1 Provide materials for concrete as per Section 03300 – Cast-in-Place Concrete.

.2 Provide concrete mix as per Section 03300 – Cast-in-Place Concrete.

3. EXECUTION

3.1 Condition of Site

.1 Preparation of site for piling will be done under Section 02223 – Excavation and Backfilling for Structures. Ensure that site conditions at each pile location are adequate to support piling equipment to properly install piles and permit load testing when required.

.2 Keep drilled holes free of water at all times, until concrete is placed.

.3 Provide necessary equipment including pumps, piping, and temporary drains and trenches.

.4 Do not discharge drainage water into municipal sewers without municipal approval.

3.2 Drilling

.1 Drill for piles where and as indicated on Drawings in the sequence as per reviewed Shop Drawings.

.2 Ensure pile shafts are drilled vertically and to depths indicated on Drawings. Piles are not to deviate from true vertical alignment more than 2% of pile length, nor more than 100 mm off centre from true location, with tops not more than 25 mm from cut-off elevations shown on Drawings.

.3 Drilling equipment will require an off-set shaft in order to position the piles directly under the walls of the valve chamber in the locations shown on the Drawings.

.4 Install steel casings in excavations if required to prevent cave-ins and water entry.

3.3 Placing Piles

.1 Provide lighting necessary for review of shaft. Immediately after acceptance, place reinforcing steel and concrete. Perform these operations on the same day, for each pile.

.2 Provide reinforcement in accordance with Drawings. Place reinforcing and secure in position. Provide concrete cover in accordance with CAN/CSA-A23.1-00.

.3 Place concrete to prevent concrete from striking sides of shaft and to prevent any foreign material from falling into shaft. Vibrate concrete in top 3 m of pile. Place concrete continuously from bottom to top.

.4 Place concrete by means of a tremie, should an inflow of water occur that cannot be removed by pumping. Place to a height sufficient to effect a seal. Notify Contract Administrator and submit placing procedures for review prior to carrying out this Work.

.5 Ensure the underside of the existing Valve Chamber base slab is clean of all dirt and loose material at each pile location. Place the concrete at the top of the pile so that there is full contact to the underside of the base slab.

.6 During cold weather, provide concrete protection in accordance with CAN/CSA-A23.1-00.

3.4 Defective Piles

.1 Contract Administrator may, at his discretion, reject any pile that is out of alignment, out of position, or otherwise fails to meet specified requirements.

.2 Replace rejected piles with new piles as directed by the Contract Administrator at no additional cost to City. Cut off rejected piles 1000 mm below design cut-off elevations.

END OF SECTION

PILE FOUNDATIONS, GENERAL

1. GENERAL

1.1 Work Included

.1 Supply and install precast concrete piles.

1.2 Storage, Handling, and Installation

.1 Protect piles from damage due to excessive bending stresses, impact, abrasion, or other causes from the point of pick-up, and during storage and handling. Install piles to stated driving tolerances.

.2 The Contract Administrator shall be the sole judge of the acceptability of supplied piles.

.3 Replace rejected piles to satisfaction of Contract Administrator. Causes for pile rejection are as follows:

.1 Out of fabrication tolerances at time of installation.

.2 Cracked, spalled, or broken piles.

.3 Out of stated driving tolerances.

2. PRODUCTS

2.1 Materials

.1 Piles to be furnished under this Contract shall be fabricated and supplied as specified in Section 02468 – Precast Concrete Piles.

.2 Piles to be furnished under the Contract shall be full length piles as indicated, without cutting and splicing requirements. Contractor shall provide equipment to handle full length piles.

.3 In the event that site conditions require pile extensions, the extensions shall be constructed in accordance with the details shown on the Drawings.

3. EXECUTION

3.1 Delivery, Storage, and Handling

.1 Protect piles from damage due to excessive bending stresses, impact, abrasion, or other causes during delivery, storage, and handling.

3.2 Equipment

.1 Prior to the commencement of pile installation, submit details of equipment for installation of piles to Contract Administrator for review.

.1 Impact hammers: provide to the Contract Administrator; Manufacturer's name, type, rated energy per blow at normal working rate, mass of striking parts of hammer, mass of driving cap and type and elastic properties of hammer and pile cushions.

.2 Hammer:

.1 Hammers to be selected on the basis of driveability analysis using wave equation theory, performed to show that piles can be driven to levels indicated.

.2 The driveability analysis shall include, but not be limited to, the following: hammer, cushion, and capblock details; static soil parameters; quake and damping factors, total soil resistance, blow count, pile stresses, and energy throughput at representative penetrations.

.3 Driveability analysis shall be submitted to the Contract Administrator for review of the hammer or hammers.

.4 When required criteria cannot be achieved with the proposed hammer, use larger hammer and take other measures as required.

.5 Drop hammers are not permitted.

.3 Leads:

.1 Construct pile driver leads to provide free movement of hammer. Hold leads in position at top and bottom, with guys, stiff braces, or other means to ensure support to pile while being driven.

.2 Length: provide length of leads so that use of a follower is unnecessary.

.3 Swing leads: firmly guy top and bottom to hold pile in position during driving operation.

.4 Followers: when permitted, provide followers of such size, shape, length, and mass to permit driving pile in desired location to required depth and resistance. Provide followers with socket or hood carefully fitted to top of pile to minimize loss of energy and prevent damage to pile.

3.3 Preparation

.1 Ensure that ground conditions at pile locations are adequate to support pile driving operation and load testing operation. Make provision for access and support of piling equipment during performance of work.

.2 Pre-bore with an auger bit to a depth of approximately 5 m but no lower than elevation 224.600; size the bit so that the driven pile seals the hole all around.

3.4 Field Measurement

.1 Contractor shall cooperate with the Contract Administrator and shall allow access during the pile installation operations so that all the field measurements can be performed expeditiously.

3.5 Driving

.1 Drive precast piles only when concrete has attained strength of 35 MPa as determined by related concrete compression testing in accordance with CSA-A23.2-00.

.2 Use driving caps and cushions to protect piles. Reinforce pile heads as required by Contract Administrator. Piles with damaged heads as determined by Contract Administrator will be rejected.

.3 Hold piles securely and accurately in position while driving.

.4 Deliver hammer blows along axis of pile.

.5 Drive piles to practical refusal, as outlined in the geotechnical information. Blow count requirements shall be determined by the Contract Administrator. If followers are used, established criteria for refusal will be increased by 50%.

.6 When driving precast concrete piles, adjust hammer, as required, to deliver reduced impact so that reflected tensile stress in pile does not exceed allowable stress.

.7 Do not drive piles within 10 m of masonry or concrete which has been in place less than seven (7) calendar days. Do not drive piles within 30 m of masonry or concrete which has been in place less than one (1) calendar day.

.8 Re-strike already driven piles lifted during driving of adjacent piles to confirm and assure set.

.9 Remove loose and displaced material from around piles after completion of driving, and leave clean, solid surfaces to receive foundation concrete.

.10 Cut off piles neatly and squarely at elevation ranges as indicated on the Drawings. Final cut off elevations will be confirmed during construction. Provide sufficient length above cut-off elevation so that the part damaged during driving is cut off. Do not cut tendons or other reinforcement which will be used to tie supported structure above to pile. A minimum of 450 mm of strands shall remain for this purpose. The cut off surface of the piles shall be mechanically chipped to expose sound concrete.

.11 Remove cut-off lengths from Site on completion of Work.

3.6 Design Load Capacity

.1 Allowable design load capacity of piles at specified loads is:

.1 400 mm diameter hex - 800 kN.

.2 Installation of each pile will be subject to the review of the Contract Administrator. Contract Administrator will be the sole judge of acceptability of each pile with respect to final driving resistance, depth of penetration, or other criteria used to determine load capacity. Contractor shall allow Contract Administrator to review final driving of all piles prior to removal of pile driving rig from Site.

3.7 Driving Tolerances

.1 Pile heads shall be within ± 100 mm of locations as indicated.

.2 Piles shall not to be more than 2% of length out of vertical alignment.

3.8 Obstructions

.1 Where obstruction is encountered that causes sudden unexpected change in penetration resistance or deviation from specified tolerances, proceed as directed by Contract Administrator.

3.9 Repair/Restoration

.1 The Contract Administrator may require one (1) or more of the following remedial measures:

.1 Pull out rejected piles and replace with new piles.

.2 Remove rejected pile and replace with a new, and if necessary, a longer pile.

.3 Remove rejected pile and fill hole as directed by Contract Administrator.

.4 Leave rejected pile in place and cut off as directed by Contract Administrator.

.5 Leave rejected pile in place, place adjacent pile(s), and modify pile cap as directed by Contract Administrator.

.2 No extra compensation will be made for removing and replacing or other work made necessary through rejection of defective piles.

3.10 Safety and Protection

.1 Protect adjacent structures, services, and work of other sections from hazards due to pile driving operations.

.2 Arrange sequencing of pile driving operations and methods such that no damage occurs to adjacent existing structures. If damaged, remedy damaged items to restore to original or better condition at own expense.

.3 Undertake review of all adjacent infrastructures with the Contract Administrator complete with a photographic record sufficient to establish pre-driving conditions of the existing adjacent infrastructure.

.4 Protection for pile strand ends:

.1 Highly visible protection safety caps shall be installed for all pile reinforcing strand ends immediately following strand exposure operations. One protection cap may be used for each pile by grouping and securely tying the strands.

.2 The protection safety caps shall be highly visible and shall be made secure so that accidental contact will not easily dislodge the caps. Dislodged caps shall be re-installed immediately.

.3 Pile reinforcing strands shall be protected from severe bending. Kinked or broken strands shall be repaired to the satisfaction of the Contract Administrator.

END OF SECTION

PRECAST CONCRETE PILES

1. GENERAL

1.1 Work Included

.1 Supply and install 400 mm diameter precast concrete piles.

1.2 References

.1 CSA:

.1 CSA- A23.1-00/A23.2-00, Concrete Materials and Methods of Concrete Construction/Methods of Test for Concrete.

.2 CSA- A23.4-00/A251-00, Precast Concrete – Materials and Construction/Qualification Code for Architectural and Structural Precast Concrete Products.

.3 CAN/CSA-A3000-03, Cementitious Materials Compendium (Consists of A3001, A3002, A3003, A3004, and A3005).

.2 ASTM:

.1 ASTM A82, Cold-Drawn Steel Wire for Concrete Reinforcement.

1.3 Design

.1 Piles shall be solid core prestressed concrete piles with longitudinal prestressing strands and spiral reinforcement.

.2 Strand tensioning stress shall be 0.7 times the tensile strength of the strand.

.3 Pile splices at predetermined locations shall be of the mechanical locking type.

1.4 Shop Drawings

.1 Submit Shop Drawings in accordance with Section 01300 – Submittals.

.2 Each drawing submitted shall bear the signature and stamp of a qualified Professional Engineer registered in the Province of Manitoba.

.3 Indicate the following items:

.1 Lifting point details and locations

.2 Storage support point locations

.3 Mechanical pile splice details complete with calculations

.4 Concrete strength

.5 Reinforcing details

.6 Type and grade of steel

1.5 Certificates

.1 Piles delivered to Site to be certified by Manufacturer that each batch of piles meets the strength requirement of 35 MPa at twenty eight (28) days.

1.6 Qualifications

.1 Pile type shall have a proven record of successful service in the Province of Manitoba of at least twenty (20) years.

2. PRODUCTS

2.1 Materials

.1 Concrete mixes and materials: to CSA-A23.1-00 and CSA-A23.4-00.

.2 Reinforcing steel: to CAN/CSA-G30.18.

.3 Cold-drawn steel wire for concrete reinforcement: to ASTM A82.

.4 Fabricate and supply full length piles as indicated and provide equipment capable to handle piles without altering them.

2.2 Concrete Mixes

.1 Proportion normal density concrete in accordance with CSA-A23.1-00, Alternative 1, to give following properties:

.1 Use Type 50 Portland Cement.

.2 Minimum compressive strength at twenty eight (28) days: 35 MPa.

.3 Minimum cement content: 365 kg/m^3 of concrete.

.4 Maximum water to cementitious material ratio: 0.45.

.5 Nominal size of coarse aggregate: 16 mm maximum.

.6 Air content: 5 to 8%, to ASTM C260.

.7 Chemical admixtures: in accordance with CAN/CSA – A3000-03.

.8 Pozzolanic mineral admixtures: in accordance with CAN/CSA-A3000-03.

3. EXECUTION

3.1 Fabrication

.1 Fabricate precast concrete piles to lengths determined in the fabrication schedule.

.2 Fabricate piles to following finish tolerances:

.1 Length: plus or minus 3 mm/m of length.

.2 Cross section:

.1 Side width: minus 5 mm to plus 10 mm

.2 Deviation from straight line: not more than 3 mm/m of length and not more than 10 mm in full length

.3 Deviation of reinforcing cage from true position: 10 mm

.4 Pile head: 10 mm/m from true right angle plane; surface irregularities 3 mm

.5 Strand projection: strands shall be cut off flush or be slightly below pile head surface

.6 Location of reinforcing steel main reinforcing cover: minus 3 mm to plus 5 mm; spiral: 10 mm.

.3 Prestress piles under the direction of an experienced and competent supervisor. All personnel operating the stressing equipment shall have been trained in its use.

.4 De-tension in a manner to keep eccentricity to a minimum.

.5 Remove rejected piles from Site.

3.2 Handling, Storage, and Delivery

.1 Inspection of the fabricated product upon shipment and certification that the product is free from any damage or defects.

.2 Replace damaged piles to satisfaction of Contract Administrator.

.3 Delivery – the Site has insufficient space for long term storage. Delivery to the Site will be on an as required-for-installation basis.

.4 Protect piles from damage due to excessive bending stresses, impact, abrasion, or other causes during delivery, storage, and handling.

.5 The Contractor shall provide lifting and handling equipment for loading of piles onto trucks for delivery to the Site.

END OF SECTION

CONCRETE FORMWORK

1. GENERAL

1.1 Work Included

.1 Forms for all concrete and supporting falsework including design

.2 Formliner all for interior wall surfaces of water retaining structures

.3 Wood or steel forms for all cast-in-place concrete

.4 Void forms between structural elements and soil below

.5 Shoring, bracing, and anchorage

.6 Form openings for other trades

.7 Coordinate installation of concrete accessories

.8 Set anchor bolts, anchors, sleeves, frames, and other items supplied by other trades

.9 Clean erected formwork prior to concrete placement

.10 Remove forms and supporting falsework.

1.2 Design Standards

.1 Design and detail forms and supporting falsework in accordance with the NBC, CAN/CSA-A23.1-00, CSA S269.1, CAN/CSA S269-3, ACI 347R, and applicable construction safety regulations.

.2 Design to be done by a Professional Engineer, registered in the Province of Manitoba.

1.3 Quality Assurance

.1 Construct and erect concrete formwork in accordance with CAN/CSA-A23.1-00, CAN/CSA S269.3, ACI 347R, and all applicable construction safety regulations for the place of Work.

1.4 Shop Drawings

.1 Submit Shop Drawings in accordance with Section 01300 – Submittals.

.2 Clearly indicate sizes, methods of construction, materials, arrangement of joints, ties and shores, location and size of falsework, schedule of erection and stripping, reshoring, etc.

.3 Shop Drawings and design briefs are to bear the seal of a Professional Engineer, registered in the Province of Manitoba.

.4 Formwork, falsework, and reshoring are to be reviewed by the same Professional Engineer prior to each concrete pour.

.5 Professional Engineer to report, in writing, that reviewed formwork, falsework, and reshoring are in accordance with the design prior to each concrete pour.

2. PRODUCTS

2.1 Exposed Surfaces

.1 Square-edged, smooth surfaced panels true in plane, free of holes, surface markings, or defects.

2.2 Unexposed Surfaces

.1 Square-edged T&G lumber, plywood or other material, suitable to retain concrete without leakage or distortion.

2.3 Wood Materials

.1 Plywood: douglas fir, conforming to CSA O121 solid one side, sheathing grade. Sound undamaged sheets with clean true edges.

.2 Lumber: conforming to CSA O141.

.3 Nails, Spikes and Staples: galvanized; conforming to CSA B111.

2.4 Prefabricated Forms

.1 Steel Type: minimum 1.6 mm steel thickness; well matched, tight fitting, and adequately stiffened to support weight of concrete without deflection detrimental to structural tolerances and appearance of finished concrete surface.

.2 Tubular Column Type: round, spirally wound laminated fibre material, internally treated with release agent; sizes indicated on Drawings.

.3 Void Form:

.1 Void Form: expanded polystyrene, structurally sufficient to support weight of reinforcing steel, wet concrete mix, and a minimum of 2.4 kPa construction live load, until initial set. The depth of collapse shall be a minimum of 250 mm. Acceptable product is GeoSpan by Plasti-Fab Ltd.

.2 Protection for void form shall be one (1) layer of 12.7 mm thick spruce plywood sheeting.

2.5 Accessories

.1 All materials used on surfaces that will be in contact with potable water shall satisfy the requirements of NSF 60/61.

.2 Plain Form Liner: acceptable product is Zemdrain MD-2 by Dupont complete with drainage profile on exterior surface of the form liner. Alternate products with proven performance, equal to that of the design standards, are subject to acceptance by the Contract Administrator.

.3 Form ties for water retaining structures: form ties shall be cone-fast coil tie type or she bolt type as manufactured by Dywidag, to provide a 50 mm deep cone pocket for grouting after use. The portion of the form tie that remains in the concrete wall shall be plated and shall utilize a hydrophylic O ring waterstop at midspan. As an alternate to these ties, a tapered removable form tie may be employed. The hole to be grouted after removal must be mechanically cleaned to remove all remnants of release or debonding agents.

.4 Form Release Agent: colourless mineral oil which will not stain concrete or impair natural bonding or colour characteristics of coating intended for use on concrete.

.5 Corner or Chamfer Fillets: mill finished pine, widths as indicated on the Drawings, maximum possible lengths, mitre ends.

.6 Reglets: mill finished pine, shaped to required cross-section, maximum possible lengths, mitre ends.

.7 Sealing Tape: reinforced, self-adhesive, waterproof kraft.

3. EXECUTION

3.1 Erection

.1 Verify lines, levels, and centres before proceeding with formwork. Ensure dimensions agree with Drawings.

.2 Construct formwork and falsework to meet design and regulatory requirements, and to produce finished concrete conforming to surfaces, shapes, lines, and dimensions indicated on Drawings.

.3 Arrange and assemble formwork to permit removal without damage to concrete.

.4 Align joints and make watertight to prevent leakage of cement paste and disfiguration of concrete. Keep form joints to a minimum. Tape as necessary.

.5 Arrange forms to allow removal without removal of principal shores, where these are required to remain in place.

.6 Obtain Contract Administrator's acceptance before framing openings in concrete slabs, walls, beams, and columns not indicated on Drawings.

.7 Provide falsework to ensure stability of formwork. Brace or strengthen all previously constructed parts liable to be overstressed by construction loads.

.8 Position form joints to suit any expressed lines required in exposed concrete.

.9 Provide chamfer on all internal and external corners and edges of exposed concrete unless shown otherwise.

.10 Form chases, slots, openings, drips, and recesses as detailed on Drawings.

.11 Set screeds with top edge level to required elevations.

.12 Check and readjust formwork to required lines and levels during placing of concrete.

.13 Locate construction joints for beams and suspended slabs where shown or noted on the Drawings.

.14 Provide reveals or reglets on construction joints as shown on the Drawings.

3.2 Void Form

.1 Void forms shall be placed on prepared surfaces of levelling sand so that the top of the void forms present flat forming surfaces.

3.3 Tolerance

.1 Construct formwork to produce concrete with dimensions, lines, and levels within tolerances specified in ACI 347R, Guide to Formwork for Concrete.

.2 Camber slabs and beams 6 mm per 3 m of span unless otherwise indicated on the Drawings. Review method of providing camber with Contract Administrator prior to proceeding. Maintain beam depth and slab thickness from cambered surface.

3.4 Inserts/Embedded Items/Openings

.1 Provide formed openings where required for pipes, conduits, sleeves, and other Work to be embedded in and passing through concrete members.

.2 Accurately locate and set in place items which are to be cast directly into concrete.

.3 Coordinate Work of other Sections and cooperate with trades involved in forming openings, slots, recesses, chases, and setting sleeves, bolts, anchors, and other inserts.

.4 Coordinate installation of concrete accessories specified in Section 03250 – Concrete Accessories.

.5 Provide temporary ports or openings in formwork where required to facilitate cleaning and construction review. Locate openings at bottom of forms to allow flushing water to drain.

.6 Close temporary ports or openings with tight fitting panels, flush with inside face of forms, neatly fitted so no leakage occurs, and to provide uniform surface on exposed concrete.

3.5 Field Quality Control

.1 Inspect and check complete formwork, falsework, shoring, and bracing to ensure that Work is in accordance with formwork design, and that supports, fastenings, wedges, ties, and parts are secure. Submit written report from Professional Engineer responsible for this Work as specified in Clause 1.4 Shop Drawings.

.2 Inform Contract Administrator when formwork is complete and has been cleaned, to allow for review. Contract Administrator's review will be for verification that forms are clean and free from debris.

.3 Allow Contract Administrator to review each section of formwork prior to re-use. Formwork may be re-used if acceptable to the Contract Administrator.

3.6 Cleaning

.1 Clean forms to remove foreign matter as erection proceeds. Remove cuttings, shavings, and debris from within forms. Flush completely with water to remove remaining foreign matter. Ensure that water and debris drain to exterior through clean-out ports.

.2 During cold weather, remove ice and snow from within forms. Do not use de-icing salts. Do not use water to clean out completed forms, unless formwork and concrete construction proceed within a heated enclosure. Use compressed air or other means to remove foreign matter.

3.7 Formwork Preparation

.1 Apply form release agent in accordance with Manufacturer's recommendations, prior to placing reinforcing steel, anchoring devices, and embedded parts.

.2 Do not apply form release agent where concrete surfaces are to receive special finishes or applied coverings which are affected by agent. Soak inside surfaces of untreated forms with clean water. Keep surfaces moist prior to placing concrete.

.3 Form liner shall be used on all water retaining wall surfaces of the Surge Tower. The form liner shall be installed in strict accordance with the Manufacturer's instructions. The Manufacturer's Representative shall be On-Site at the beginning of the formliner installation and as required to ensure recommended procedures are followed. Wrinkles or folding of the formliner during concrete placement will not be accepted.

3.8 Form Removal

.1 Notify Contract Administrator prior to removing formwork.

.2 Do not remove forms and falsework until concrete has gained sufficient strength to carry its own weight, plus construction and design loads which are liable to be imposed. Verify strength of concrete by compression tests to satisfaction of Contract Administrator.

.3 Forms shall remain in place a minimum of two (2) calendar days and the concrete shall have attained 75% of design strength verified by field cured test cylinders.

.4 Remove falsework progressively, in accordance with regulatory requirements and ensure that no shock loads or imbalanced loads are imposed on structure.

.5 Loosen forms carefully without damaging concrete surfaces. Do not apply tools to exposed concrete surfaces.

.6 If forms are left loosely in place for protection until curing requirements are complete, ensure all concrete surfaces are kept continuously wet with use of soaker hoses. Otherwise remove forms and start wet cure immediately by use of soaker hoses or accepted curing compound.

3.9 Reshoring

.1 If reshoring is required, prepare and submit a schedule to Contract Administrator for review.

.2 Reshore structural members where required due to design requirements or construction conditions under the direction of the Professional Engineer responsible for this Work.

.3 Install reshoring as required to permit progressive construction.

END OF SECTION

CONCRETE REINFORCEMENT

1. GENERAL

1.1 Work Included

.1 Reinforcing steel bars and welded steel wire fabric for cast-in-place concrete complete with tie wire.

.2 Support chairs, bolsters, bar supports, and spacers for reinforcing.

1.2 Quality Assurance

.1 Perform concrete reinforcing Work in accordance with CAN/CSA-A23.1-00.

1.3 Inspection and Testing

.1 If requested by Contract Administrator, submit three (3) certified copies of mill test report of reinforcement supplied, indicating physical and chemical analysis.

1.4 Shop Drawings

.1 Submit bar lists and placing drawings in accordance with Section 01300 – Submittals.

.2 Clearly indicate bar sizes, spacings, locations, and quantities of reinforcing steel and wire fabric, bending and cutting schedules, and supporting and spacing devices.

.3 Drawings and details to conform to CAN/CSA-A23.1-00, CAN/CSA-A23.3, and RSIC Reinforcing Steel Manual of Standard Practice.

.4 Detail placement of reinforcing where special conditions occur.

.5 Detail lap lengths and bar development lengths to CAN/CSA-A23.1-00, unless otherwise shown on the Drawings.

1.5 Delivery and Storage

.1 Deliver, handle, and store reinforcement in a manner to prevent damage and contamination.

.2 Deliver bars in bundles, clearly identified in relation to bar lists.

2. PRODUCTS

2.1 Reinforcing Materials

.1 Reinforcing Steel: minimum 400 MPa yield grade; deformed billet steel bars conforming to CAN/CSA-G30.18; plain finish.

.2 Welded Steel Wire Fabric: plain type, conforming to ASTM A185; flat sheets; plain finish.

.3 Stainless Steel Bars: ASTM Type 316.

2.2 Accessory Materials

.1 Tie Wire: minimum 1.6 mm annealed type, or patented system accepted by Contract Administrator.

.2 Chairs, Bolsters, Bar Supports, Spacers: adequately sized for strength and support of reinforcing steel during construction.

.3 Bar Chairs for exposed surfaces: to be non-corrosive PVC chairs or concrete chairs purpose made. Steel bar chairs, galvanized bar chairs, concrete bricks, broken concrete blocks, or wood supports are not acceptable.

.4 Bar Chairs for non-exposed surfaces: Broken concrete blocks, stones, and wood supports are not acceptable.

.5 Side form spacers to be non-corrosive PVC spacers, purpose made. PVC chairs, steel bar chairs, galvanized bar chairs, concrete bricks, broken concrete blocks, or wood supports are not acceptable.

.6 Threaded Couplers: conforming to CSA-A23.3, ACI 318, and ACI 349, complete with temporary cap as manufactured by Bar Grip Canada or accepted alternate. Review with Contract Administrator prior to use.

3. EXECUTION

3.1 Fabrication

.1 Fabricate reinforcing steel in accordance with CAN/CSA-A23.1-00 and Drawings.

.2 Locate reinforcing splices not indicated on Drawings at points of minimum stress.

.3 Fabricate within the following tolerances:

.1 Sheared length: plus 0, minus 25 mm.

.2 Depth of truss bars: plus 0, minus 10 mm.

.3 Stirrups, ties, and spirals: plus 0, minus 10 mm.

.4 Other bends: plus 0, minus 25 mm.

.4 All bending shall be done cold with a suitable machine accurately producing all lengths, depths, and radii shown on the bending details.

.5 After initial fabrication, reinforcing steel shall not be rebent or straightened unless so indicated on the Drawings.

.6 Heating of reinforcing steel will not be permitted.

3.2 Installation

.1 Place reinforcing steel in accordance with reviewed placing Drawings and CAN/CSA-A23.1-00. Chair slab reinforcing not further apart than 1.2 m in either direction. Tie reinforcing steel at maximum spacing 600 mm.

.2 Adequately support reinforcing and secure against displacement within tolerances permitted.

.3 Place reinforcing steel to provide concrete cover required by CAN/CSA-A23.1-00, but not less than shown on Drawing Concrete Notes.

.4 Maintain alignment as follows:

Item	**Tolerances (mm) Plus or Minus**
Slabs	5
Other Structural Members	10
Rebar Bends and Ends	50

.5 Do not disturb or damage polyethylene film or void form while placing reinforcing steel.

.6 Install protective sleeves on horizontal slab and footing dowels and projecting bars to prevent concrete splatter from contaminating bars. Remove sleeves prior to next concrete pour.

.7 Install purpose made highly visible protective safety caps on all exposed projecting bar ends to the satisfaction of the Contract Administrator.

3.3 Cleaning

.1 Ensure concrete reinforcing is clean and free from oil and deleterious matter.

.2 Remove all loose scale, loose rust, concrete from prior pours, and other deleterious matter from surfaces of reinforcing.

.3 Remove concrete splatter on bars before concrete has hardened.

END OF SECTION

CONCRETE ACCESSORIES

1. GENERAL

1.1 Work Included

.1 Joint Sealants

.2 Joint Filler

.3 PVC and Expansive Waterstops

.4 Epoxy grout

.5 Non-ferrous Grout

.6 Latex Patching Agent

.7 Epoxy Bonding Agent

.8 Curing Compound

.9 Moisture Retention Film

.10 Fasteners.

2. PRODUCTS

2.1 General

.1 All materials that will come in contact with potable water shall meet the requirements of NSF 60/61.

.2 All materials shall be subject to the acceptance of the Contract Administrator.

2.2 Materials

.1 Joint Sealants:

.1 Sealants for all joints shall be non-sag two-part polysulphide, NSF approved for contact with potable water, Thiokol 2235M by PolySpec or accepted alternate.

.2 Use compatible primer as per sealant Manufacturer's requirements.

.2 Joint Filler:

.1 Expansion joint filler: rigid closed cell foam, CPD PVC Closed Cell Joint Filler or accepted alternate.

.3 Waterstops:

.1 PVC waterstops shall conform to CGSB 41-GP-35M Polyvinyl Chloride Waterstop, size indicated on Drawings, edges wire looped for tying. Acceptable product is Wirestop CR-6380 by Paul Murphy.

.2 PVC waterstop joints (tees, crosses, and L's) shall be factory manufactured by waterstop Manufacturer.

.3 Waterstop PVC shall meet or exceed the performance criteria of Corps of Engineers Specification CRD-C 572-74 and the following:

.1	Tensile strength	13.8 megapascals
.2	Ultimate elongation	370% minimum
.3	Hardness Shore A	80 ± 3
.4	Stiffness in flexure	4.8 megapascals
.5	Water absorption	0.5 maximum (48 hours)

.4 All PVC waterstop material shall be Arctic Grade.

.5 Expansive Waterstop: potable grade, acceptable product is CS-231 Controlled Expansion Waterstop by ConSeal Concrete Sealants.

.4 Epoxy grout: Sika Talygrout, CPD Epoxy Grout, or accepted alternate.

.5 Non-ferrous Grout: Pre-mixed, non-shrink, Master Builders 713, Sika M-Bed, CPD Non-Shrink Grout, Steel C1 Grout, Grace In-Pakt Grout, minimum 35 megapascals compressive strength.

.6 Latex Patching Agent: Acrl Stix, Daraweld-C Latex Bonding Agent, or accepted alternate.

.7 Epoxy Bonding Agent: Master Builders Concresive 1001 LPL, Dural Duralbond, Sikadur 32 HI-bond, or accepted alternate.

.8 Moisture Retention Film: Master Builders Confilm or accepted alternate.

.9 Fasteners: fasteners (all nuts, bolts, washers, screws, etc.) stainless steel for all aluminum items, conforming to American Society for Testing and Materials (ASTM) 304 or 316, sizes and locations as required by item manufacturer.

2.3 Shop Drawings

.1 Submit Shop Drawings in accordance with Section 01300 – Submittals.

.2 Submit product information for review for materials to be incorporated into the Work.

3. EXECUTION

3.1 Installation

.1 Coordinate Work of this Section with other construction.

.2 Install all concrete accessories in accordance with Drawings and Manufacturer's recommendations and ensure compatibility. Install straight, level, and plumb.

.3 Ensure items are not disturbed during concrete placement.

.4 Curing and sealing compounds are to be used for curing purposes of all concrete where practical or compatible with finishes. Main floor of the Outlet and Inlet Buildings shall be moist cured as per Section 03300 – Cast-in-Place Concrete.

.5 Joint sealant shall be applied per manufacturer's instructions. If joint surfaces are damp, dry and apply primer as recommended by Manufacturer.

.6 Joint filler shall be installed per manufacturer's instructions in expansion joints as indicated on Drawings.

.7 PVC Waterstop:

.1 Install PVC waterstop in expansion joints as indicated on Drawings.

.2 All joints other than straight butt joints shall be factory fabricated by the waterstop Manufacturer.

.3 Install waterstop continuous without displacing reinforcement. Butt weld splices too Manufacturer's directions. Secure in place to prevent dislodgment during placing of concrete. All filed splices to be heat-fused and tested for complete seals by use of a corona discharge unit. Costs for testing to paid for by Contractor.

.4 Take particular care to correctly position the waterstop during installation. Tie the waterstop adequately for support in accordance with Manufacturer's instructions, but at spacings no greater than 300 mm to ensure proper embedment, symmetrical about the joint, and to prevent displacement during concrete placement. Fully compact the concrete in the region of the waterstop during the placing of the concrete.

.5 Do not place concrete until waterstop has been reviewed by the Contract Administrator.

.8 Latex Patching Agent is to be used for patching formed concrete surfaces where required.

.9 Epoxy Bonding Agent is to be used to bond new concrete to existing concrete surfaces.

END OF SECTION

CAST-IN-PLACE CONCRETE

1. GENERAL

1.1 Work Included

.1 All reinforced cast-in-place concrete shown on the Drawings

.2 Setting anchors, inserts, frames, sleeves, and other items supplied by other Sections

.3 Repairing concrete imperfections

.4 Finishing formed concrete surfaces

.5 Watertightness testing of water retaining structures

.6 Curing of concrete.

1.2 Quality Assurance

.1 Cast-in-place concrete shall conform to the CSA CAN/CSA-A23.1-00.

.2 Testing shall conform to CAN/CSA-A23.2-00.

.3 These standards shall be available in the Contractor's Site office for the use of the Contractor, sub-trades, and Contract Administrator.

.4 A Concrete Pour Release Form shall be completed prior to each concrete pour. The Contractor shall be responsible for completing the forms. Each form shall be signed by the Contractor and Contract Administrator prior to each pour.

1.3 Qualification

.1 Concrete flatwork finishing is to be done by an established firm having at least five (5) years of proven, satisfactory experience in this trade and employing skilled personnel.

.2 Submit proof of qualifications in writing to the Contract Administrator.

1.4 Inspection and Testing

.1 Notify the Contract Administrator at least forty eight (48) hours before complete formwork and concrete reinforcement is ready for review. Reinforcing in walls shall be reviewed prior to closing forms.

.2 Allow ample time for notification, review, and corrective Work, if required, before scheduling concrete placement.

.3 Concrete sampling, inspection, and testing is to be performed by a CSA certified inspection and testing firm appointed and paid for by the City.

.4 Provide unencumbered access to all portions of Work and cooperate with appointed firm.

.5 Submit proposed mix design of each class of concrete to the Contract Administrator for review two (2) weeks prior to commencement of the Work.

.6 Tests of cement and aggregates may be performed to ensure conformance with requirements stated herein.

.7 Notify the Contract Administrator at least twenty four (24) hours in advance of any concrete placement.

.8 At least three (3) concrete test cylinders will be taken for every seventy five (75) or less cubic metres of each class of concrete placed.

.9 At least three (3) test cylinders will be taken daily for each class of concrete placed.

.10 One (1) slump test and one (1) air content test will be taken for each set of test cylinders taken.

.11 Additional slump and air content tests may be taken as necessary (up to every truck) to verify quality of concrete at the discretion of the Contract Administrator.

.12 Testing of concrete will be performed in accordance with CAN/CSA-A23.2-00. Test results will be issued to the Contractor, the Contract Administrator, and the City.

.13 The Contractor shall pay costs for required retesting due to defective materials or workmanship.

.14 If accepted by the Contract Administrator, the Contractor may arrange and pay for additional tests for use as evidence to expedite construction.

.15 Additional tests for concrete for the main tank walls

.1 At least two (2) cores will be taken from hardened concrete for rapid chloride permeability of concrete in accordance with ASTM C1202.

.2 At least two (2) cores will be taken from the hardened concrete for air content of hardened concrete in accordance with ASTM C457.

.16 To conform to the strength requirements, the average of all tests shall exceed the specified strength. When three (3) or more tests of the same class of concrete are available, the average of any three (3) consecutive tests shall be equal to, or greater than the specified strength, and no strength test shall fall more than 3.5 mPa below the specified strength. If any of the criteria of the above clause are not met, the Contract Administrator shall have the right to require one or more of the following:

.1 Changes in mix proportions for the remainder of the Work.

.2 Cores drilled and tested from the areas in question as directed by the Contract Administrator and in accordance with CAN/CSA-A23.2-00. The test results shall be indicative of the strength of the in-place concrete.

.3 Load testing of the structural elements.

.4 The changes in the mix proportions, cores drilled and tested, and load testing shall be at the Contractor's expense.

.5 Concrete failing to meet the strength requirements of this Specification shall be strengthened or replaced at the Contractor's expense and to the satisfaction of the Contract Administrator.

2. PRODUCTS

2.1 General

.1 All materials that will come in contact with potable water shall meet the requirements of NSF 60/61.

2.2 Concrete Materials

.1 Cementitious Materials:

.1 Portland Cement: Normal Type 10 and Type 50 conforming to CSA-A3000

.2 Pozzolans: Type C fly ash, conforming to CSA-A3000, source of material to be acceptable to the Contract Administrator

.3 Silica Fume: Conforming to CSA-A3000.

.2 Fine Aggregate: Conforming to Normal-Density Fine Aggregate, CAN/CSA-23.1-00. If requested by the Contract Administrator, submit evidence at least two (2) weeks before use in concrete mix showing conformance to Normal-Density Fine Aggregate, CAN/CSA-A23.1-00, Table 4 and Table 6.

.3 Coarse Aggregate: Conforming to Normal-Density Coarse Aggregate, CAN/CSA-23.1-00, Group I, 40-5 mm, 20-5 mm, and 10 to 2.5 mm. If requested by the Contract Administrator, submit evidence at least two (2) weeks before use in concrete mix showing conformance to Normal-Density Coarse Aggregate, CAN/CSA-A23.1-00, Table 5 and Table 6. Group II may be used for special requirements such as gap grading, pumping, or for blending two (2) or more sizes to produce Group I gradings.

.4 Ensure that no aggregates are used that may undergo volume change due to alkali reactivity, moisture retention, or other causes. Confirm suitability of aggregate with a petrographic analysis if deemed necessary by the Contract Administrator.

.5 Water: Potable, clean, and free from injurious amounts of oil, alkali, organic matter, or other deleterious matter.

.6 Materials are to be obtained from the same source of supply or Manufacturer for the duration of the Contract.

2.3 Admixtures

.1 No admixtures other than air-entraining agent, water-reducing agent, and superplasticizer shall be used without the written authorization of the Contract Administrator, unless specified.

.2 Air entrainment: conforming to ASTM Standard C260.

.3 Water-reducing agent: Type WN conforming to ASTM Standard C494.

.4 Superplacticizer: conforming to ASTM Standard C494.

.5 General Chemical Admixtures: conforming to ASTM Standard C494.

.6 Calcium chloride or admixtures containing calcium chloride shall not be used in concrete.

2.4 Accessories

.1 Curing Sealer: sodium silicate, Miracle Kote or accepted alternate.

.2 Moisture Retention Film: Master Builders Confilm or accepted alternate.

2.5 Concrete Mixes

.1 Pay all costs for mix design. Submit mix designs to the Contract Administrator for review a minimum of two (2) weeks prior to concrete pour.

.2 Provide concrete mixed in accordance with requirements of CAN/CSA-A23.1-00 and as indicated on the Drawings. The Drawing requirements shall govern where there is a difference between the Drawings and CAN/CSA-A23.1-00, Tables 6 to 10 requirements.

.3 Maximum allowable substitution of cement with fly ash material shall be 20% by weight.

.4 Concrete for main tank wall

.1 Concrete for the tower wall shall contain silica fume.

.2 Substitution of cement with silica fume material shall be a maximum 8% by weight. A Portland Cement, fly ash, and silica fume pre-blended mix is acceptable.

.3 Super-plasticizer shall be used for the concrete for the wall. Slumps measured immediately prior to placing or pumping shall be no more than 230 mm. After discharging of a truck-load of concrete has started, only one re-dose of the super-

plasticizer will be allowed. The Contractor shall ensure that segregation of the concrete does not occur.

.4 Rapid chloride permeability of concrete at twenty eight (28) days determined in accordance with ASTM C1202 shall be equal to or less than 1500 Coulombs.

.5 Air content of hardened concrete shall have a minimum of 3% total air content and average spacing factor per lot no more than 250 µm with no individual test result greater than 200 µm as determined in accordance with ASTM C457.

.6 A field trial batch (one truck load) shall be tested at least thirty five (35) days prior to commencement of placement of the concrete for the tank wall. When acceptable to the Contract Administrator, the concrete from the trial batch may be incorporated into parts of the structure that require a lesser strength of concrete. In lieu of a trial batch, the Contract Administrator may accept evidence from the Contractor that the same materials and mix design have previously met the above requirements for concrete on another contract within a calendar year.

.5 Use accelerating admixtures in cold weather only when accepted by the Contract Administrator. If accepted, the use of admixtures will not relax cold weather placement requirements. Do not use calcium chloride.

.6 Use set-retarding admixtures during hot weather only when accepted by the Contract Administrator.

.7 All materials and admixtures must be compatible within the mix. Concrete with freezing and thawing exposure must satisfy the durability requirements of CAN/CSA-A23.1-00, Sections 14 and 15.

.8 All admixtures are subject to acceptance by the Contract Administrator. List all proposed admixtures in mix design submission. Do not change or add admixtures to accepted design mixes without the Contract Administrator's review and acceptance.

.9 The water:cementitious materials ratio must be calculated and shown based on all available mixing water excluding aggregate absorption.

.10 Concrete delivered to Site must be accompanied by a delivery slip indicating time of completion of mixing, design strength of concrete, air content, and actual water-cement ratio.

.11 Patching Mortar:

.1 The patching mortar shall be made of the same material and of approximately the same proportions as used for the concrete, except that the coarse aggregate shall be omitted and the mortar shall consist of not more than 1 part cement to 2.5 parts sand by damp loose volume.

.2 White Portland Cement shall be substituted for a part of the grey Portland Cement on exposed concrete in order to produce a colour matching the colour of the surrounding concrete, as determined by a trial patch.

.3 The quantity of mixing water shall be no more than necessary for handling or placing. Mixing water shall include 1 part latex bonding agent to 3 parts water. Maximum water to cement ratio shall be 0.40.

.12 Self-compacting concrete mixes will not be permitted for use in this Work.

3. EXECUTION

3.1 Placing Concrete

.1 Place concrete in accordance with requirements of CAN/CSA-A23.1-00 and as indicated on the Drawings. Layout of the Work and accuracy of same is the Contractor's sole responsibility.

.2 Notify the Contract Administrator a minimum of twenty four (24) hours prior to pouring concrete. Under no circumstances shall concrete be poured without notifying Contract Administrator, or in his absence, arranging for review of the Work and sampling of concrete.

.3 The concrete shall be placed rapidly and evenly as near to its final position as possible to reduce the risk of segregation, flowlines, and cold joints. Concrete shall be placed within 1.5 hours of mixing. For concrete that includes silica fume and fly ash, this requirement is reduced to 60 minutes.

.4 Ensure all anchor bolts, seats, plates, and other items to be cast into concrete are securely placed and will not interfere with concrete placement.

.5 All equipment for transporting the concrete shall be cleaned of hardened concrete and foreign materials before placing concrete.

.6 Immediately before concrete is placed, Contractor shall carefully inspect all forms to ensure that they are properly placed, sufficiently rigid and tight, and that all reinforcing steel and embedded parts are in the correct position and secured against movement during the placing operation. All forms shall be thoroughly cleaned and material removed.

.7 Concrete shall be handled from the mixer to the place of final deposit as rapidly as practicable by methods, which will prevent the separation or loss of the ingredients. Concrete shall be deposited in the forms as nearly as practicable in its final position to avoid re-handling or flowing. Vibrators shall not be used to move concrete. Under no circumstances shall the concrete, which has partially hardened, be deposited in the forms.

.8 Concrete shall be thoroughly compacted by mechanical vibrators during placing operations. It shall be thoroughly worked around the reinforcement, embedded fixtures, and into the corners of the forms.

.9 Vibrate concrete using the appropriate size equipment as placing proceeds, in accordance with CAN/CSA-A23.1-00. Check frequency and amplitude of vibrations prior to use. Provide additional standby vibrators in the event of equipment failure.

.10 Prepare set or existing concrete by removing all laitance and loose or unsound materials and apply bonding agent in accordance with Manufacturer's recommendations.

.11 Where placing operations would involve dropping the concrete more than 1500 mm, it shall be placed through canvas hoses or galvanized iron chutes. Concrete shall not be raised at a rate greater than that for which proper vibration may be affected.

.12 In locations where new concrete is dowelled to existing concrete, drill holes in existing concrete, insert steel dowels, and pack solidly with non-shrink grout.

.13 A minimum of three (3) days shall elapse between adjacent pours separated by construction joints or expansion joints.

.14 Do not place concrete if carbon dioxide producing equipment has been in operation in the building or in the enclosure during the twelve (12) hours preceding the pour. This equipment shall not be used during placing or for twenty four (24) hours after placing. During placing and curing concrete, surfaces shall be protected by formwork or an impermeable membrane from direct exposure to carbon dioxide, combustion gases, or drying from heaters.

.15 Honeycomb or embedded debris is not acceptable.

.16 Remove and replace defective concrete.

.17 Maintain accurate records of cast-in-place concrete items. Record date, location of pour, quantity, air temperature, and test samples taken.

3.2 Cold Weather Concreting

.1 The requirements of this section shall be applied to all concreting operations during cold weather, i.e., if the mean daily temperature falls below 5°C during placing or curing.

.2 Supplementary equipment as required below shall be at the job Site if concrete is likely to be placed in cold weather.

.3 Formwork and reinforcing steel shall be heated to at least 5°C before concrete is placed.

.4 The temperature of the concrete shall be maintained at not less than 10°C for seven (7) calendar days. The concrete shall be kept above freezing temperature for at least a period of seven (7) calendar days. In no case, shall the heating be removed until the concrete has

reached a minimum compressive strength which will be specified by the Contract Administrator as determined from compressive strength tests on specimens cured under the same conditions as the concrete Works in question.

.5 Aggregates shall be heated to a temperature of not less that 20°C and not more than 65°C. Water shall be heated to a temperature between 55°C and 65°C. The temperature of the concrete at the time of placing in the forms shall be within the range specified in CAN/CSA-A23.1-00 for the thickness of the section being placed.

.6 When the mean daily temperature may fall below 5°C, a complete housing of the Work, complete with heaters, fuel, maintenance, and attendants, shall be provided.

.7 Combustion-type heaters may be used if their exhaust gases are vented outside the enclosures and not allowed to come into contact with concrete surfaces. Fire extinguishers must be readily at hand wherever combustion-type heaters are used.

.8 When the ambient temperature is below -15°C, the housing shall be constructed so as to allow the concrete to be placed without the housing having to be opened. If the mixing is done outside of the housing, the concrete shall be placed by means of hoppers installed through the housing. The hoppers are to be plugged when not in use.

.9 When the ambient temperature is equal to or above -15°C, the Contractor will be permitted to open small portions of the housing for a limited time to facilitate the placing of the concrete.

.10 Before depositing any of the concrete, the Contractor shall show that enough heating equipment is available to keep the air temperature surrounding the forms within the specified range. This shall be accomplished by bringing the temperature inside of the housing to the specified 10°C at least twelve (12) hours prior to the start of the concrete placing.

.11 The Contractor shall supply all required heating apparatuses and the necessary fuel. When dry heat is used, a means of maintaining atmospheric moisture shall be provided.

.12 Sufficient standby heating equipment must be available to allow for any sudden drop in outside temperatures and any breakdowns which may occur in the equipment.

.13 The Contractor shall keep a curing record of each concrete pour. The curing record shall include date and location of the pour, mean daily temperature, temperatures above and below the concrete within the enclosures, temperatures of the concrete surface at several points, and notes regarding the type of heating, enclosure, unusual weather conditions, etc. This record shall be available for review by the Contract Administrator at all times, and shall be turned over to the Contract Administrator at the end of the concreting operations.

3.3 Hot Weather Concreting

.1 General

.1 The requirements of this section shall be applied during hot weather, i.e., air temperatures above 25°C during placing.

.2 Concrete shall be placed at as low a temperature as possible, preferably below 15°C, but not above 27°C. Aggregate stockpiles may be cooled by water sprays and sun shades.

.3 Ice may be substituted for a portion of the mixing water provided the ice has melted by the time mixing is completed.

.4 Form and conveying equipment shall be kept as cool as possible before concreting by shading them from the sun, painting their surfaces white, and/or the use of water sprays.

.5 Sun shades and wind breaks shall be used as required during placing and finishing.

.6 Work shall be planned so that concrete can be placed as quickly as possible to avoid "cold joints".

.7 The Contract Administrator's acceptance is necessary before the Contractor may use admixtures such as retardants to delay setting, or water-reducing agents to maintain workability and strength, and these are to be included in the mix designs submitted to the Contract Administrator.

.8 Curing shall follow immediately after the finishing operation.

.2 Hot-Weather Curing

.1 When the air temperature is at or above 25°C, curing shall be accomplished by water or by using saturated absorptive fabric, in order to achieve cooling by evaporation. Mass concrete shall be water cured for the basic curing period when the air temperature is at or above 20°C, in order to minimize the temperature rise of the concrete.

.3 Job Preparation

.1 When the air temperature is at or above 25°C, or when there is the probability of its rising to 25°C during the placing period, facilities shall be provided for protection of the concrete in place from the effects of hot and/or drying weather conditions. Under severe drying conditions, as defined in Clause 3.3.5.2 of this Specification Section, the formwork, reinforcement, and concreting equipment shall be protected from the direct rays of the sun or cooled by fogging and evaporation.

.4 Concrete Temperature

.1 The temperature of the concrete as placed shall be as low as practicable and in no case greater than that shown below for the indicated size of the concrete section.

Thickness of Section (metres)	Temperatures (°C)	
	Minimum	Maximum
less than 0.3	10	27
0.3 – 1	10	27
1.2	5	25

.5 Protection from Drying

.1 Moderate Drying Conditions

.1 When surface moisture evaporation exceeds 0.75 kg/m^2/hr, windbreaks shall be erected around the sides of the structural element.

.2 Severe Drying Conditions

.1 When surface moisture evaporation exceeds 1.0 kg/m^2/hr, additional measure shall be taken to prevent rapid loss of moisture from the surface of the concrete. Such additional measures shall consist of the following:

.1 Erecting sunshades over the concrete during finishing and placing operations.

.2 Lowering the concrete temperature.

.3 Increasing humidity by applying fog spray immediately after placement and before finishing.

.4 Care shall be taken to prevent accumulation of water that may reduce the quality of the cement paste.

.5 Beginning the concrete curing immediately after trowelling.

.3 Surface Moisture Evaporation Rate

.1 The monograph, Figure D1, Appendix D of CAN/CSA-A23.1-00 shall be used to estimate surface moisture evaporation rates.

3.4 Concrete Protection for Reinforcement

.1 Ensure reinforcement is placed to provide minimum concrete cover in accordance with Section 03200 – Concrete Reinforcement.

3.5 Construction Tolerance

.1 The Work shall be carefully and accurately set out; true to the positioning, levels, slopes, and dimensions shown on the Drawings and conforming to Sections 03100 – Concrete Formwork and 03200 – Concrete Reinforcement.

.1 Sizes of Member or Thickness of Slabs: +6 mm, - 0 mm.

.2 Cover of Concrete over Reinforcement: ±3 mm.

.3 Variations from Plumb: 6 mm in 3.0 m, 10 mm maximum.

.4 Variations from Flat: 3 mm in 3.0 m, 6 mm maximum.

.2 If these tolerances are exceeded the Contractor may, at the discretion of the Contract Administrator, be required to remove and replace or to modify the placed concrete before acceptance. The costs incurred by the Contract Administrator for such investigation, testing, or review of reconstruction and the cost of reconstruction shall be borne by the Contractor.

3.6 Finishing Slab Surfaces

.1 Finish all slab surfaces conforming to CAN/CSA-A23.1-00, Clause 22 and as specified below.

.2 Bull Floating

.1 Flatness for suspended concrete slabs to be achieved by means of hiway straight edge (minimum 3 m width) in lieu of standard bull float. Immediately after screeding, bull float floor surfaces to remove ridges and fill voids.

.2 Complete bull floating before any excess moisture or bleed water is visible on surface.

.3 Mechanical Floating

.1 Mechanical float floor surfaces when bleed water has disappeared and surfaces are sufficiently hard to prevent working excess mortar to surface.

.2 Continue floating as necessary to produce surfaces of uniform texture, free from hollows, bumps, and screed marks.

.3 For surfaces to be trowelled, continue floating as necessary to embed coarse aggregate particles firmly below surface mortar.

.4 Hand float in corners, restricted areas, and around cast-in items.

.4 Trowelling

.1 Trowel floor surfaces with mechanical trowelling machines fitted with steel blades.

.2 Commence trowelling when surfaces are sufficiently hard to prevent working excess fine material to surface.

.3 Perform additional trowelling at intervals so final trowelling is done just before concrete becomes so hard that further trowelling is ineffective.

.4 Finish trowelled surfaces to be hard, dense, and free from blemishes and other imperfections.

.5 Hand trowel in corners, restricted areas, and around cast-in items.

.6 Cure concrete as specified.

.7 Protect all floors from damage during construction.

3.7 Curing and Protection

.1 Cure and protect freshly placed concrete in accordance with Clause 21 of CAN/CSA-A23.1-00.

.2 All concrete shall receive moist curing for a period of at least seven (7) calendar days. One (1) of the following methods shall be used as soon as the concrete has hardened sufficiently to prevent marring:

.1 Surface covered with canvas or other satisfactory material and kept thoroughly and continuously wet with soaker hoses.

.2 A liquid membrane forming curing sealer, applied at the rate recommended by the Manufacturer. Curing sealer shall not be used on a surface where bond is required for the finishes.

.3 Surfaces of concrete, which are protected by formwork that is left in place for seven (7) calendar days, shall not require any additional curing (except as specified for hot weather). If the formwork is removed in less than seven (7) days, the concrete shall receive moist curing as above. Surfaces of concrete not protected by formwork, such as tops of walls and construction joints, shall receive moist curing.

.3 No concreting will be allowed until all materials required for the curing phase are on Site and ready for use.

.4 At the end of the curing and protection period, the temperature of the concrete shall be reduced gradually at a rate not exceeding 10°C per day until the outside air temperature has been reached.

.5 Concrete that is allowed to freeze or attain insufficient curing conditions shall be subject to all necessary investigations and testing as deemed necessary by the Contract Administrator and all such concrete shall be removed and the portion reconstructed as directed by the Contract Administrator, at Contractor's cost.

.6 The supply (both quantity and time of supply) of water for curing concrete shall be subject to control of the City and prior arrangements shall be made by the Contractor with the City for its supply. The Contractor shall be responsible for, at his own cost, to supply, install, maintain, and move extensions to water services as required for conveying water to the Site. Water required for curing concrete will be supplied by the City, from the DBPS.

3.8 Formed Concrete

.1 Allow the Contract Administrator to review concrete surfaces immediately upon removal of the forms.

.2 Modify or replace concrete not conforming to qualities, lines, details, and elevations specified herein or indicated on the Drawings to the acceptance of the Contract Administrator.

3.9 Finishing Formed Surfaces

.1 Interior formed concrete surfaces.

.1 Walls of water retaining structures to receive form liner finish as per Section 03100 – Concrete Formwork.

.2 Finish surfaces exposed to view to Smooth-Form Finish conforming to CAN/CSA-A23.1-00, Clause 24.3.6.

.3 Finish non-exposed surfaces to Rough-Formed Finish conforming to CAN/CSA-A23.1-00, Clause 24.3.5.

.2 Exterior formed concrete surfaces.

.1 Finish surfaces to receive vapour barrier, insulation, waterproofing material, or roofing material to Smooth-Formed Finish conforming to CAN/CSA-A23.1-00, Clause 24.3.6.

.2 Finish other non-exposed surfaces to Rough-Formed Finish conforming to CAN/CSA-A23.1-00, Clause 24.3.5.

.3 Finish surfaces exposed to view to Smooth-Form Finish conforming to CAN/CSA-A23.1-00, Clause 24.3.6.

3.10 Equipment Pads and Cast in Metal Frames

.1 Provide concrete pads and supports for equipment where and as indicated on Drawings. Adjust dimensions to reviewed equipment Shop Drawings.

.2 Insert bolts and sleeves and pack solidly with non-shrink grout, in accordance with setting details and templates.

.3 Steel trowel surface smooth. Chamfer exposed horizontal and vertical edges.

.4 Clean excess concrete from metal frames, inserts, weld plates, etc. Clean and tool concrete around the above noted items.

3.11 Grouting

.1 Grout all miscellaneous anchor bolts with non-ferrous or epoxy grout as specified using templates for accurate positioning.

.2 Grout under base plates and other items to provide continuous support over the entire contact area as required and shown on the Drawings.

3.12 Defective Concrete

.1 Concrete not meeting the requirements of the Specifications and Drawings will be considered defective concrete.

.2 Concrete not conforming to the lines, details, and grades specified herein or as shown on the Drawings shall be modified or replaced at the Contractor's expense and to the satisfaction of the Contract Administrator. Finished lines, dimensions, and surfaces shall be correct and true within tolerances specified herein and in Section 03100 – Concrete Formwork.

.3 Concrete not properly placed resulting in honeycombing and other defects shall be repaired or replaced at the Contractor's expense and to the satisfaction of the Contract Administrator.

3.13 Patching

.1 Allow Contract Administrator to review concrete surfaces immediately upon removal of all formwork.

.2 Remove all exposed metal form ties, nails and wires, break off fins, and remove all loose concrete.

.3 Any imperfect joints, voids, stone pockets, or other defective areas and tie holes, as specified, shall at once be patched before the concrete is thoroughly dry. Defective areas shall be chipped away to a depth of not less than 40 mm with the edges perpendicular to the surface. The area to be patched and a space at least 150 mm wide entirely surrounding it shall be wetted to prevent absorption of water from the patching mortar.

.4 Cure all patches thoroughly in accordance to Manufacturer’s instructions.

3.14 Watertightness Testing

.1 All water retaining concrete structures (tower and overflow channel) shall be watertight and all precautions shall be taken, especially concrete construction joint treatment and concrete joints around pipes, to construct watertight structures.

.2 Notify the Contract Administrator at least two (2) Business Days before commencing the watertightness test.

.3 The structures, when full, shall be reviewed over a forty eight (48) hour period for leakage including monitoring of visible leaks and testing for leaks by measurement. Each compartment or cell shall be tested independently. The testing of the Surge Tower tank shall be performed in stages as outlined in the Construction Sequence noted on the Drawings.

.4 Filling the structures in preparation of the watertightness test shall be performed only after the wall concrete has attained 100% of the design strength and may be performed prior to roof construction. The test shall be performed prior to the demolition of the outfall pipe.

Fill the tanks with clean water forty eight (48) hours prior to the watertightness test to allow for full saturation of the concrete.

.5 The supply (both quantity and time of supply) of water for the watertightness test shall be subject to control of the City and prior arrangements shall be made by the Contractor with the City for its supply. The Contractor shall be responsible for, at his own cost, to supply, install, maintain, and move extensions to water services as required for conveying water to the Site. Water required for the watertightness testing will be supplied by the City, from the DBPS.

.6 The Contractor shall measure leakage during next forty eight (48) hour period. The measurements shall be witnessed by the Contract Administrator. With the water at maximum operating level for forty eight (48) hours, there shall be no visible moisture or wetness on areas that will be seen or backfilled and the leakage measured over a period of twenty four (24) hours shall not exceed 0.10% of the water volume in the test period.

.7 Locate and repair all leaks until all leakage is remedied and repeat the forty eight (48) hour watertightness test following each repair operation, at no additional cost to the City.

.8 All water used for retesting shall be supplied by the City as outlined in Paragraph 5 above. Disposal of the water for the initial test and all retests shall be overland on Site as directed by the Contract Administrator and shall be at the Contractor's expense.

3.15 Construction Joints

.1 Construction joint locations shall be as shown on the Drawings.

.2 Joints not indicated on the Drawings shall be located so as to least impair the strength of the structure. The location of these joints shall be subject to prior review and acceptance by the Contract Administrator. Joints shall be in accordance with CAN/CSA-A23.1-00, or as indicated on the Drawings.

.3 The surface of hardened concrete shall be thoroughly cleaned of foreign matter and laitance by sand blasting, and shall be thoroughly wetted with water, but not saturated, and the forms shall be re-tightened against the face of the hardened concrete before depositing additional concrete. Any concrete splatter on reinforcing bars shall be removed by sand blasting.

.4 PVC waterstop shall be protected with suitable 12 mm thick protection boards on both sides secured firmly together by mechanical clamps (i.e. c-clamps) or other method acceptable to the Contract Administrator during the sand blast cleaning operations.

.5 For horizontal construction joints, the concrete shall be thoroughly compacted by hand trowel in and around the reinforcing bars and along the PVC waterstops.

3.16 Clean-Up

.1 As Work progresses and at the completion of Work, remove from Site all debris, excess materials, and equipment.

END OF SECTION

MASONRY PROCEDURES

1. GENERAL

1.1 Quality Assurance

.1 Conform to requirements of CSA A370, CSA A371 and design requirements of CAN3-S304-M or CSA S304.1 except where more stringent requirements are noted and/or indicated on Drawings and specified herein.

.2 Provide for compartments in long cavity wall and at corners to achieve appropriate pressure equalization and drainage in cavity wall design.

.3 Engineered Masonry: Conform to CSA A371 and CAN3-S304 and to details as indicated on structural Drawings.

1.2 Samples

.1 Submit duplicate full-size units samples or samples of size indicated, of each type of products specified for the Work, cured and finished in manner specified, and physically identical with material or product selected, and that show full range of colour and texture variations expected.

.1 Masonry Units: Full size units.

.2 Masonry Accessories: 300 mm (12") long.

.3 Masonry Reinforcement, Ties and Corners: 300 mm (12") long, or full size sample.

1.3 Test Reports

.1 Submit triplicate copies of test reports.

.1 Masonry Units and Mortar Ingredients: Certifying compliance of masonry units and mortar ingredients with specification requirements.

1.4 Delivery, Storage And Handling

.1 Deliver materials to the Site in dry condition.

.2 Keep materials dry until use.

.3 Store under waterproof cover on pallets or plank platforms held off ground by means of plank or timber skids.

1.5 Environmental Requirements

.1 Cold Weather Requirements: Supplement Clause 5.15.2 of CSA-A371 with following requirements:

.1 Maintain temperature of mortar between 5°C and 50°C until batch is used.

.2 Hot Weather Requirements

.1 Protect freshly laid masonry from drying too rapidly, by means of waterproof, non-staining coverings.

.2 Keep masonry dry using waterproof, non-staining coverings that extend over walls and down sides sufficient to protect walls from wind driven rain, until masonry Work is completed and protected by flashings or other permanent construction.

.3 Protect masonry and other work from marking and other damage. Protect completed work from mortar droppings. Use non-staining coverings.

.4 Provide temporary bracing of masonry Work during and after erection until permanent lateral support is in place.

2. PRODUCTS (NOT USED)

3. EXECUTION

3.1 Installation

.1 Do masonry Work in accordance with CSA-A371 except where specified otherwise.

.2 Build masonry plumb, level, true to line, with vertical and horizontal joints in alignment.

.3 Layout coursing and bond to achieve correct coursing heights, and continuity of bond above and below openings, with minimum of cutting.

3.2 Construction

.1 Exposed Masonry: Remove chipped, cracked, and otherwise damaged units in exposed masonry and replace with undamaged units.

.2 Jointing:

.1 Concave Joints: Allow mortar to set just enough to remove excess water, then tool with round jointer to provide smooth, joints true to line, compressed, uniformly concave joints.

.2 Flush Joints: Strike flush all joints concealed in walls and joints in walls to receive plaster, tile, insulation, or other applied material except paint or similar thin finish coating.

.3 Cutting:

.1 Cut out for electrical switches, outlet boxes, and other recessed or built-in objects.

.2 Make cuts straight, clean, and free from uneven edges.

.4 Building-In:

.1 Build in items required to be built into masonry.

.2 Prevent displacement of built-in items during construction. Check plumb, location and alignment frequently, as Work progresses.

.3 Brace door jambs to maintain plumb. Fill spaces between jambs and masonry with mortar.

.5 Support of Loads:

.1 Use concrete to requirements of Division 3 Section Cast-in-Place Concrete, where concrete fill is used in lieu of solid units.

.2 Use grout to CSA A179 where grout is used in lieu of solid units.

.3 Install building paper below voids to be filled with concrete or grout; keep paper 25 mm (1”) back from faces of units.

.6 Provision for Movement:

.1 Built masonry to tie in with stabilizers, with provision for vertical movement.

.7 Cavity Walls:

.1 Construct cavity walls with cavity free of mortar. Strike mortar joints in both wythes flush at cavity faces.

.8 Site Tolerances:

.1 Tolerances in notes to Clause 5.3 of CSA-A371 apply.

END OF SECTION

MASONRY MORTAR AND GROUT

1. GENERAL

1.1 General Requirements

.1 Conform to requirements of Division 4 Section Masonry Procedures.

1.2 Quality Assurance

.1 Do mortar and grout work in accordance with CSA A179 except where specified otherwise.

.2 Use same brands of materials and source of aggregate for entire project.

.3 Irregularity in mortar joints for wall faces exposed or painted in the completed Work: Not be noticeable when viewed from a distance of 4500 mm (15' to 0").

2. PRODUCTS

2.1 Materials

.1 Use same brands of materials and source of aggregate for entire project.

.2 Colour Additives: Non-staining, non-fading, ground coloured natural aggregates or metallic oxide pigments.

.3 Aggregate: CSA A179, except that the maximum allowable percentage passing 600 µm (No. 30) sieve shall be 80% and maximum passing 300 µm (No. 50) sieve shall be 50%.

.4 Cement: Normal Portland, CAN/CSA-A5.

.5 Hydrated Lime: ASTM C207; Type S.

.6 Integral Water Repellent Admixture For Exterior Concrete Masonry Units And Concrete Mortar: Liquid polymeric admixture mixed with concrete during manufacture of concrete masonry units and added to mortar during mortar mixing in accordance with Manufacturer's recommendations. Integral water repellent admixture system shall provide Class E Rating when tested in accordance with ASTM E514. Dry Block System by WR Grace.

2.2 Mortar Types

.1 Mortar for Interior and Exterior Masonry Above Grade: CSA A179

.1 Loadbearing: Type S.

.2 Non-Loadbearing: Type N.

.2 Mortar for Stone Masonry Units: 1 part Portland cement, 1 part hydrated lime, 6 parts aggregate by volume.

.3 Non-Staining Mortar: Use non-staining masonry cement for cementitious portion of specified mortar type.

.4 Grout: CSA A179, Table 3.

.5 Parging Mortar: Type N.

2.3 Mixes

.1 Measure and mix mortar materials based to CSA A179 based on proportion specifications.

.2 Use Portland cement in mortar for exterior masonry work and masonry cement for interior masonry Work.

.3 Incorporate admixtures into mixes in accordance with Manufacturer's instructions.

.4 Do not mix different types of mortar or grout in the same mixer unless the mixer is thoroughly cleaned first.

.5 Type N Mortar: At Contractor’s option, one of the following:

.1 Pre-mixed mortar: CSA A179, Portland Cement/lime/aggregate, Type N, by St. Lawrence Cement Company, Canada Cement, St. Mary Cement or Lake Ontario Cement Ltd. Mix, use and store in accordance with manufacturer's instructions to produce small batches for immediate use only. Discard mixed mortar after 2 hours.

.2 Site silo mix: CSA A179, portland cement/lime/aggregate, Type N, by Mega-Mix Ltd. or Max-Mix Ltd. or Jiffy Concrete Products. Mix required amount from Site silo as required. Take representative samples for testing consistency of strength in accordance with CSA A179. Use mortar within two (2) hours after mixing at temperature of 26°C (79°F), or 2.5 hours at temperatures under 10°C (50°F).

.6 Pointing Mortar: Prehydrate pointing mortar by mixing ingredients dry, then mix again adding just enough water to produce damp unworkable mix that will retain its form when pressed into ball. Allow to stand for not less than one 1 hour nor more than 2 hours then remix with sufficient water to produce mortar of proper consistency for pointing.

3. EXECUTION

3.1 Application

.1 Do masonry mortar and grout Work in accordance with CSA A179 except where specified otherwise.

.2 Parging: Apply parging in uniform coating not less than total 10 mm (3/8”) thick.

3.2 Repointing

.1 Repoint defective joints.

.2 Cut back joints 13 mm (0.5”) taking care not to damage units. Remove dust and loose materials by brushing or by water jet. If water jet is used, allow excess water to drain before repointing.

.3 Repoint with same mix and colour as original.

.4 Pack mortar tightly in thin layers, and tool joint to match non defective joints.

END OF SECTION

MASONRY REINFORCEMENT AND CONNECTORS

1. GENERAL

1.1 General Requirements

.1 Conform to requirements of Division 4 Section Masonry Procedures.

1.2 Source Quality Control

.1 Upon request, provide Consultant with certified copy of test report of connectors, showing physical and chemical analysis, minimum twenty (20) business days prior to commencing reinforcement Work.

2. PRODUCTS

2.1 Materials

.1 Acceptable Products: Subject to compliance with requirements of this Section, products that may be incorporated into the Work include, but are not limited to, the products specified.

.2 Cavity Wall Ties, Concrete Back Up: Engineered ties, properly sized, consisting of 1.6 mm (0.060") thick stainless steel L plate, 4.76 mm (0.19") diameter stainless steel v ties, and polyethylene insulation support, Heavy Duty Rap-Tie by Fero Corp.

3. EXECUTION

3.1 Installation

.1 Do work in accordance with CSA-A370, CSA-A371, and CSA-S304.1 unless indicated otherwise.

.2 Cavity Wall Ties: Space ties at 800 mm (32") horizontally and 400 mm (16") vertically.

END OF SECTION

MASONRY ACCESSORIES

GENERAL

1.1 General Requirements

.1 Conform to requirements of Division 4 Section Masonry Procedures.

2. PRODUCTS

2.1 Materials

.1 Acceptable Products: Subject to compliance with requirements of this Section, products that may be incorporated into the Work include, but are not limited to, the products specified.

.2 Control Joint Filler: Purpose-made, rubber, size and shape to suit end use as recommended by the Manufacturer, Rapid Control Joint by Dur-O-Wal.

.3 Dampproof Course and Flashing: Self-adhering modified bitumen membrane reinforced with proprietary polymer facing, minimum thickness 1 mm (40 mils), complete with Manufacturer recommended primer and lap adhesive, compatible with air barrier system specified in Division 7 Section Air Barrier, Blueskin TWF Flashing System by Bakor.

.4 Weep Hole Vent: Cellular plastic, one-piece, flexible extrusion made from UV resistant polypropylene copolymer, full height and width of mortar joint and depth 3 mm ($^1/_8$") less than depth of outer wythe, in color selected from manufacturer's standard.

.5 Mortar Dropping Control Device: Mor-Control by Dur-O-Wal, full thickness of cavity wall air space.

3. EXECUTION

3.1 Installation – Control Joints

.1 Control Joints: Provide control joint fillers in masonry walls as indicated on Drawings and where wall height changes; where wall thickness changes; openings in walls such as doors and windows; and at intervals in continuous walls as follows:

.1 Up to 2400 mm (8') high: 9000 mm (30') to 10500 mm (35') oc.

3.2 Installation - Weep Hole Vents

.1 Install weep hole vents in vertical joints immediately over flashings, in exterior wythes of cavity wall and masonry veneer wall construction, at maximum horizontal spacing of 600 mm (24") oc.

.2 Ensure that holes in vents are not plugged with mortar or debris.

3.3 Installation – Dampproof Course And Flashing

.1 Supply and install dampproof courses and flashings where indicated on Drawings. If not fully indicated, install in the following locations.

.1 Exterior Walls, General: Install flashings and dampproofing courses to provide continuous waterproofing flashing.

.2 Cavity Walls: Full thickness of exterior wythe, horizontally across cavity and through insulation to terminate shingle style with minimum 150 mm (6") vertical leg behind air barrier. Maintain integrity of air barrier without damaging flashing, membrane and insulation.

3.4 Installation – Mortar Dropping Control Devices

.1 Place mortar dropping control device in air space of cavity walls horizontally starting 200 mm (8”) above the damp proof course.. Space devices at maximum 800 mm (32”) horizontally.

.1 Ensure mortar droppings are kept to a minimum and do not bridge air space as wythe is erected.

END OF SECTION

CONCRETE MASONRY UNITS

1. GENERAL

1.1 General Requirements

.1 Conform to requirements of Division 4 Section Masonry Procedures.

2. PRODUCTS

2.1 Concrete Masonry Units

.1 Standard Concrete Block Units: CAN3-A165 Series, modular size.

.2 Use normal weight concrete where finished face exposed to exterior or to earth below grade.

.1 H/15/A/M: Locations where structural members bear on concrete block, and where indicated on Drawings: Fill units solid for top 2 courses of load bearing walls.

.3 Where concrete masonry walls are required to act as fire separations or barriers, provide units conforming to the building code with respect to classification, thickness, fire resistant ratings and type of concrete.

.4 Special Shapes: Provide bull-nosed and double bull nosed units for exposed corners. Provide purpose-made shapes for lintels and bond beams. Provide additional special shapes as indicated.

.5 Architectural Concrete Block Units: CAN3-A165 Series, modular size, integral water repellent treated to yield resistance to water penetration for 62 hours when tested to ASTM E514.

.1 Decorative Face Treatment: Split face.

.2 Colour: From the Manufacturer's standard colour range.

3. EXECUTION

3.1 Installation - Concrete Masonry Units

.1 Lay block to align plumb over each other with thick ends of webs up. Leave no cells open in exposed Work.

.2 Minimize cutting block. Cut exposed block with power driven abrasive cutting disc or diamond cutting wheel where cutting is required and for flush mounted electrical outlets, grilles, pipes, conduit, leaving 3 mm ($^1/_8$") maximum clearance.

.3 Do not wet concrete masonry before or during laying in wall.

.4 Bond: Stagger end joints in every course. Align joints plumb over each other in every other course.

.5 Buttering corners of units, throwing mortar droppings into joints, deep or excessive furrowing of bed joints will not be permitted. Do not shift or tap units after mortar has taken initial set. Where adjustment must be made after mortar has started to set, remove mortar and replace with fresh supply.

.6 Lay all joints approximately 10 mm ($^3/_8$") thick unless otherwise specified or otherwise indicated on Drawings. Fill joints full of mortar except where specifically designated to be left open.

.7 Jointing: When mortar is thumb print hard, tool joints slightly concave for exposed Work; elsewhere, strike joints flush. Use sufficient force to press mortar tight against masonry units on both sides of joints. Remove excess material or burrs left after jointing. Use trowel or rub with burlap bag.

.8 Use full bed of mortar for first course. For remaining courses bed face shells and cross and end webs and vertical end joints fully in mortar. Compress end joint mortar.

3.2 Cleaning

.1 Standard and Architectural Units: Allow mortar droppings on masonry to partially dry then remove by means of trowel, followed by rubbing lightly with small piece of block and finally by brushing.

.2 Pointing: Clean block faces using soft cloths before mortar hardens rake to 10 mm ($^3/_8$"). After completion of block laying fill joints with pointing mortar then point to provide concave joints. Repeat cleaning of faces.

END OF SECTION

STEEL FABRICATIONS

1. GENERAL

1.1 Work Included

.1 Shop fabricated steel items with plain or galvanized finish. The following is a list of principal items only. Refer to Drawings for items not specifically listed.

.1 Pipe support assemblies (beams, saddles, columns, bars – plain)

.2 Overflow pipe lateral supports (galvanized)

.3 Exterior masonry supports (galvanized)

.4 Roof fall protection anchor assembly (galvanized)

.5 Anchors, plates, bolts, nuts, screws, brackets, etc. required for Work of this Section.

1.2 Design Code, Quality Assurance

.1 Design, fabricate, and install all items to conform to requirements of the National Building Code of Canada, 1995.

.2 Perform welding in accordance with requirements of CSA W59.

.3 Welding Work on all items and assemblies is to be performed by a firm certified by the Canadian Welding Bureau to the requirements of CSA W47.1 in Division 2.1.

1.3 Shop Drawings

.1 Submit Shop Drawings in accordance with Section 01300 - Submittals.

.2 Clearly indicate profiles, sizes, connections, attachments, reinforcing, anchorage, size and type of fasteners and accessories.

.3 Include erection drawings, elevations, and details where applicable.

.4 Indicate welded connections using CISC standard welding symbols. Clearly indicate net weld lengths.

.5 Shop Drawings and design briefs are to be signed and sealed by a Professional Engineer registered in the Province of Manitoba.

2. PRODUCTS

2.1 Materials

.1 Steel: conforming to CAN/CSA-G40.21; Type W with minimum yield strength of 350 MPa.

.2 Welding materials: conforming to CSA W59.

.3 Bolts, nuts, and washers: conforming to ASTM A325 unless specified otherwise.

.4 Fall protection anchor assembly: provide in this contract one permanent fall protection anchor assembly on the roof in the location shown on the Drawings. Anchor shall be designed to meet CSA Z259.16 with a minimum capacity of 22.2 kN horizontally in all directions. Acceptable product is Roof Anchor #AN777A as manufactured by Protecta complete with Anchor D-Ring #AN112A.

2.2 Finishes

.1 Primer: CISC/CPMA 2-75.

.2 Galvanizing: conforming to CAN/CSA-G164. Galvalume for touch-up.

2.3 General Fabrication

.1 Verify all dimensions on-site prior to shop fabrication.

.2 Fabricate items of sizes and profiles detailed on Drawings, with joints neatly fitted and properly secured.

.3 Fit and shop assemble in largest practical sections, for delivery to Site.

.4 Supply all components required for proper anchorage of steel fabrications. Fabricate anchorage and related components of same material and finish as metal fabrications, unless otherwise specified or shown.

.5 Weld connections where possible, otherwise bolt connections. Counter-sink all exposed fastenings. Cut off bolts flush with nuts.

.6 Accurately form all connections and joints with exposed faces flush, mitres and joints tight.

.7 Grind or file exposed welds and metal sections smooth and flush as required.

.8 Provide for flush welded or hairline butt field joints.

.9 Shop fabricate openings in members for other building components. Reinforce openings to restore member to original design strengths.

.10 Provide lugs, clips, brackets, hangers, and struts as required for attaching miscellaneous metal items securely to building structure.

.11 Thoroughly clean all surfaces of rust, scale, grease, and foreign matter prior to prime painting or galvanizing.

.12 Galvanize items as shown and prime paint the remainder. Do not shop prime surfaces in contact with or embedded in concrete or requiring field welding.

3. EXECUTION

3.1 Erection

.1 Obtain Contract Administrator's permission prior to Site cutting or making adjustments which are not part of scheduled work.

.2 Install items plumb, square and level, fit accurately, and maintain free from distortion or defects detrimental to appearance and performance.

.3 Make provision for erection stresses and temporary bracing. Keep work in alignment at all times.

.4 Replace items damaged in course of installation.

.5 Perform required field welding. Grind all visible field welds smooth.

.6 Perform necessary cutting and altering for the installation of work of other Sections, and as indicated on Drawings. No additional cutting is to be done without the permission of the Contract Administrator.

.7 Perform all field assembly bolting and welding to match standard of shop bolting and welding. Bolts and screws are to be concealed whenever possible.

.8 After installation, touch up field bolts, nuts, welds, and scratched and damaged prime painted surfaces. Field touch-up primer to be same as shop primer. Touch up galvanized surfaces with galvalume.

.9 Supply, to appropriate Sections, items required to be cast into concrete and built into masonry, complete with necessary setting templates.

.10 Install roof safety anchor assembly in strict accordance with Manufacturer's instructions.

END OF SECTION

ALUMINUM FABRICATIONS

1. GENERAL

1.1 Work Included

.1 Supply and installation of aluminum landings and grating

.2 Supply and installation of aluminum ladders

.3 Supply and installation of extendable safety ladder post

.4 Supply and installation of aluminum access hatch frames to be cast into concrete

.5 Stainless steel bolts for bolted connections

.6 Stainless steel anchor bolts and anchorages for all aluminum equipment supplied.

1.2 Standards

.1 Do aluminum Work to CSA CAN3-S157.

.2 Welding to CSA W59.2.

.3 Company certification to CSA W47.2.

1.3 Shop Drawings

.1 Submit Shop Drawings in accordance with Section 01300 – Submittals.

.2 Clearly indicate profiles, sizes, connection attachments, reinforcing, anchorage, size and type of fasteners, and accessories.

.3 Include erection drawings, elevations and details where applicable.

.4 Indicated welded connections using CISC standard welding symbols. Clearly indicate net weld lengths.

2. PRODUCTS

2.1 Materials

.1 Aluminum: to CSA Standard HA, 6061-T6 or 6351-T6 Alloy unless specified otherwise.

.2 Nuts, bolts, and fastening devices connecting aluminum parts to aluminum, concrete, or other materials: stainless steel ASTM Type 316 , with appropriate isolation devices.

.3 Bituminous Paint: alkali-resistant.

.4 Aluminum Grating: acceptable aluminum alloy is CSA Standard HA 6063-T6 for bearing bars and 6063-T5 for cross bars; acceptable Product is Fisher & Ludlow Fisholow Aluminum Grating, Type 30-102M or accepted alternate.

.5 Extendable safety ladder post: the assembly shall be designed with a telescoping tubular section that locks automatically when fully extended. Upward and downward movement shall be controlled by a stainless steel spring balancing mechanism. Unit shall be completely assembled with fasteners for securing to the ladder rungs in accordance with the Manufacturer's instructions. Acceptable product is LadderUP Safety Post Model LU4 as manufactured by The Bilco Company.

2.2 General Fabrication

.1 Verify all dimensions On-Site prior to fabrication.

.2 Connect bearing bars in a panel with a bar of same depth as bearing bars and minimum thickness of 5 mm.

.3 Finish openings requiring the cutting of four (4) or more bearing bars in the same manner as the end of the panel.

.4 Match position of bars and tie rods in adjacent panels to preserve a continuous appearance.

.5 Cover exposed aluminum surfaces with pressure sensitive heavy protection paper or apply strippable plastic coating before shipping to Site. Leave protective covering in place until final cleaning of structures. Provide instruction for removal of protective covering.

3. EXECUTION

3.1 Erection

.1 Obtain the Contract Administrator's permission prior to Site cutting or making adjustments which are not part of the scheduled Work.

.2 Install items plumb, square and level; fit accurately, and maintain free from distortion or defects detrimental to appearance and performance.

.3 Make provisions for erection stresses and temporary bracing. Keep Work in alignment at all times.

.4 Replace items damaged in course of installation.

.5 Perform required field welding. Visible field welds to be smooth, grind as required.

.6 Perform necessary cutting and altering for the installation of Work of other Sections, and as indicated the Drawing. No additional cutting is to be done without the acceptance of the Contract Administrator.

.7 Perform all field assembly bolting and welding to match standard of shop bolting and welding. Bolts and screws are to be concealed whenever possible.

.8 Clip adjacent grating panels edges together at 1,500 mm spacing to prevent differential vertical movement.

.9 Provide two (2) hold-down clips at each end of the panels if not detailed on the Drawings.

.10 Provide anchors for setting in concrete with minimum 100 mm embedment.

.11 Paint aluminum surfaces in contact with concrete with two (2) coats of alkali-resistant bituminous paint.

.12 Prevent electrolysis between aluminum and dissimilar metals in contact with appropriate isolation devices.

.13 Install extendable safety ladder post in accordance with Manufacturer's instructions.

END OF SECTION

ROUGH CARPENTRY

1. GENERAL

1.1 Design Requirements

.1 Design construction methods for expansion and contraction of materials. Adopt method of construction to ensure that materials are rigidly and securely attached and will not be loosened by Work of other Sections. Fasten wood nailers, blocking, framing, and strapping solidly to adjacent materials in true planes.

1.2 Quality Assurance

.1 Lumber Identification: Lumber identification shall conform to requirements of Standard Grading Rules for Canadian Lumber of National Lumber Grades Authority (NLGA) or grade stamped by an agency certified by Canadian Lumber Standards Accreditation Board.

.2 Plywood identification: by grade mark in accordance with applicable CSA standards.

.3 Align and plumb faces of furring and blocking to tolerance of 1:600.

1.3 Submittals

.1 Submit Shop Drawings in accordance with Section 01300 – Submittals.

.2 Preservative Treatment Test Reports: Duplicate reports from chemical treatment manufacturer and certification by independent testing agency comply with requirements. Indicate type of preservative used, net amount of preservative retained, and chemical treatment Manufacturer's written instructions for handling, storing, installing, and finishing treated material.

.3 For products receiving a waterborne treatment, include statement that moisture content of treated materials was reduced to levels specified before shipment to Project Site.

.4 Include copies of warranties from chemical treatment Manufacturers for each type of treatment.

1.4 Waste Disposal

.1 Dispose waste legally Off-Site, in accordance with governing regulation. Dispose of any end-cuts and left over chemicals in an approved land-fill site. Do not burn or allow other use of end-cuts.

2. PRODUCTS

2.1 Materials

.1 Framing Lumber: Unless specified otherwise, Spruce/Pine/Fir (SPF), NLGA 121b Standard, with structural members meeting minimum No. 2 Grade requirements of CAN/CSA-O141.

.2 Cants, Curbs, Blocking, Nailers and other Members Less Than 89 mm (4") Wide: Spruce, 122c. "Standard" light framing, except as otherwise specified.

.3 Softwood Plywood, Douglas Fir, CSA O121-M of Following Grades: Good One Side (G1S) elsewhere.

.4 Rough Hardware: CSA B111; Nails, screws, bolts, lag screws, anchors, special fastening devices and supports required for erection of carpentry components. Use galvanized components if exposed to exterior atmosphere. Galvanize in accordance with requirements of CAN/CSA-G164-M.

.5 General purpose adhesive: CSA O112 Series.

.6 Proprietary fasteners: Toggle bolts, expansion shields and lag bolts, screws and lead or inorganic fibre plugs, explosive actuated fastening devices, recommended for purpose by manufacturer.

3. EXECUTION

3.1 Installation - General

.1 Install members true to line, levels, and elevations.

.2 Construct continuous members from pieces of longest practical length.

.3 Install spanning members with crown-edge up.

.4 Install materials so that grade-marks and other defacing marks are not visible or are removed by sanding.

.5 Frame, anchor, fasten, tie, and brace members to provide necessary strength and rigidity.

.6 Countersink bolts where necessary to provide clearance for other work.

.7 Fasten work to hollow units with toggle bolts and to solid masonry or concrete with lead expansion shields and lag screws. Do not use organic fibre or wood plugs.

3.2 Furring And Blocking

.1 Install furring and blocking as required to space-out and support casework, cabinets, wall and ceiling finishes, facings, fascia, soffit, siding and other work as required.

.2 Install furring to support siding applied vertically and where sheathing is not suitable for direct nailing.

3.3 Nailing Strips, Grounds and Rough Bucks

.1 Install rough bucks, nailers, and linings to rough openings as required to provide backing for frames and other work.

3.4 Cants, Curbs, Fascia Backing

.1 Install wood cants, fascia backing, nailers, curbs, and other wood supports as required and secure using galvanized fasteners.

3.5 Electrical, Data and Telephone Equipment Backboard

.1 Provide fire retardant treated backboards for mounting equipment as indicated. Use 19 mm ($^{3}/_{4}$") thick plywood on 38 mm x 89 mm (2" x 4") furring around perimeter and at maximum 300 mm (12") intermediate spacing.

END OF SECTION

BUILDING INSULATIONS

1. GENERAL

1.1 General Requirements

.1 This Section specifies insulation work not specified in other Sections. Refer to other Sections for the respective insulation requirements.

1.2 Delivery, Storage and Handling

.1 Deliver materials to Site in their original wrappings with labels intact.

.2 Store insulation on raised platforms and protect with waterproof covers. Prevent exposure of insulation to UV exposure.

.3 Store materials inside buildings for 24 hours prior to installation.

2. PRODUCTS

2.1 Materials

.1 Perimeter Insulation: CAN/ULC S-701 Type 4, expanded, extruded polystyrene board insulation, minimum compressive strength of 210 kPa (30 psi) at 10% deformation or yield; square edges, unfaced, Styrofoam SM by Dow Chemical Canada Inc.'

.2 Cement Mortar Mix: 1 part Portland cement, 6 part masonry sand, 1 part hydrated lime, potable water to produce a workable mix.

.3 Lightweight Cement Board: Made of Portland cement, sand, and expanded polystyrene beads, with a fully embedded alkali resistant glass fibre mesh facing. Unipan, Uniflex or PermaBase from Unifix inc., or Durock by CGC.

3. EXECUTION

3.1 Preparation

.1 Ensure that surfaces to receive adhesive or insulation are dry, firm, straight, and free from loose material, projections, ice, frost, slick, grease, oil or other matter detrimental to bond of the adhesive or uniform bedding of the insulation.

.2 Maintain surface and ambient temperatures during application and curing of adhesive at a temperature recommended by the manufacturer of the type of adhesive used.

3.2 Installation - General

.1 Install insulation to maintain continuity of thermal protection to building elements and spaces as indicated on Drawings.

.2 Cut and trim insulation neatly to fit spaces. Butt joints tightly, offset vertical joints. Use only insulation panels free from ripped backs or chipped or broken edges.

.3 Install materials in accordance with Manufacturer's instructions.

.4 Do not cover insulation until it has been reviewed by Contract Administrator.

3.3 Installation – Perimeter Insulation and Cement Board

.1 Apply full coat of cement mortar mix to foundation walls.

.2 Apply insulation boards vertically on perimeter foundation walls extending to depth indicated.

.3 Lightweight cement board

.1 Fasten cement boards to support structure with appropriate screws at every 200 mm (8’’), and at a minimum edge distance of 10 mm ($^3/_8$"). Drive screws so that screw heads are flush with board surface without damaging the fibreglass mesh facing. Ensure that the boards are well attached and that they are in continuous contact with the support.

.2 Install 50 mm x 50 mm (2” x 2”) 20 gauge galvanised steel corner casing bead at interior and exterior corners, using concealed fasteners.

.3 Do not attach other work directly to cement boards.

.4 Do not impede drainage of the system. Do not create water back-ups.

END OF SECTION

SPRAYED FOAM INSULATION AIR BARRIER

1. GENERAL

1.1 General requirements

.1 Sections of Division 1 apply to work of this Section.

1.2 Quality Assurance

.1 Installer Qualification: Member of CUFCA, trained and approved by the Manufacturer and having a minimum three (3) years experience in the installation of the work described in this Section and can show evidence of satisfactory completion of projects of similar size, scope and type. If requested, provide letter of certification from manufacturer stating that installer is certified applicator of its products, and is familiar with proper procedures and installation requirements required by the Manufacturer.

.2 Pre-Installation Meeting: Prior to commencing Work of this Section, arrange for Manufacturer's technical representative to visit the site and review preparatory and installation procedures to be followed, conditions under which the work will be done, and inspect the surfaces to receive the work of this Section. Advise the Contract Administrator of the date and time of the meeting.

.3 Manufacturer’s Site Inspection: Have the Manufacturer’s technical representative inspect the Work at suitable intervals during application and at conclusion of the Work of this Section, to ensure the Work is correctly installed. When requested, submit Manufacturer’s inspection reports and verification that the Work of this Section is correctly installed.

.4 Site Testing: Conduct site tests of sprayed work as required by the CUFCA:

.1 Verify core density.

.2 Verify adhesion between the transition membrane and the substrate.

.3 Verify cohesion/adhesion between the insulation material and the Substrate.

.4 Ensure results are in compliance and enter them in the CUFCA daily report.

.5 Sample Installation: Provide a 3 m x 3 m (10' x 10') representative sample installation of work of this Section on site at location directed by Contract Administrator to set quality standards for application. Remove rejected sample installation and provide additional sample installations until acceptance is given. Do not commence work until sample installation has been accepted. Accepted sample installation may form part of the completed Work if undisturbed at time of Substantial Performance.

.1 Acceptance of sample installations does not constitute approval of deviations from the Contract Documents contained in sample installations unless such deviations are specifically approved by Contract Administrator in writing.

1.3 Submittals

.1 Submit Shop Drawings in accordance with Section 01300 – Submittals.

.2 Submit applicator's certification that work has been applied in accordance with Manufacturer's design and acceptable to the authorities having jurisdiction.

1.4 Delivery, Storage, and Handling

.1 Deliver and store materials in dry, protected area, off ground in original undamaged, sealed containers. Discard any bags or containers that has been exposed to water before use.

1.5 Project Conditions

.1 Maintain air and substrate temperature of 5°C for 24 hours prior to installation, during and for a minimum of 24 hours after application of materials. Provide heated enclosures to maintain temperatures.

2. PRODUCTS

2.1 Materials

.1 Foam Insulation and Air Barrier: CAN/ULC-S705.1, sprayed applied polyurethane foam, 30 kg/cu.m. minimum density, flame spread 375 and smoke develop 288 to CAN/ULC S102, Walltite by BASF Canada, complete with primer as required.

.2 Transition Membrane: 1 mm (40 mils) thick modified bituminous composite sheet, "Perm-A-Barrier" by W.R. Grace Co. of Canada Ltd., Blueskin SA by Bakor Inc., Air-Shield by WP Meadows, or Sopraseal Stick 1100 by Soprema, complete with primer, mastic and liquid membrane as required.

3. EXECUTION

3.1 Examination

.1 Do not apply work until all clips, angles, inserts, sleeves and similar items have been installed in areas to receive work of this Section.

.2 Ensure that surfaces to receive work are compatible with materials and bond.

3.2 Preparation

.1 Provide temporary enclosures and masking to prevent spray from contaminating adjacent areas and surfaces.

.2 Protect adjacent surfaces and equipment from damage by overspray, fall out, and dusting of sprayed materials.

.3 Clean surfaces free of dust, dirt, oil, grease, loose paint, mill scale, rust and other foreign matter which would interfere with bond requirements.

.4 Prime substrates as recommended by manufacturer.

.5 Joints and Openings: Prepare with transition membrane.

.1 Apply membrane to primed substrate in 2400 mm (8') lengths or as recommended by the membrane manufacturer. Apply membrane so that horizontal joints overlap 50 mm with the upper sheet over the lower sheet, shingle style. Overlap side joints minimum 64 mm.

.2 Apply a trowelled head of mastic to all terminations of the membrane at the end of a day's work and at membrane terminations.

.3 Reinforce all inside and outside corners with a continuous 300 mm (12") wide sheet membrane.

.4 Fill gaps and joints with liquid membrane and reinforce with a continuous 300 mm (12") wide sheet membrane prior to installing the air/vapour barrier.

.5 Use liquid membrane at all protrusions and difficult detail areas and provide a minimum 64 mm (2.5") overlap with the sheet membrane.

.6 Install membrane over doors, windows and other openings to exterior walls. Extend membrane 200 mm (8") beyond jambs, heads and sills.

.7 Use mastic or fixing bars to adhere membrane to windows, doors, and other openings to maintain air barrier continuity.

3.3 Application

.1 Apply work in accordance with Manufacturer’s written recommendations.

.2 Apply work in consecutive layers of no less than 13 mm and no more than 50 mm thick for a uniform total thickness indicated, at a tolerance of plus/minus 6 mm.

.1 Avoid forming air pockets between layers.

.2 Do not apply work closer than 75 mm from chimneys, heating vents, steam pipes, recessed lighting fixtures, and other heat sources. Do not spray the insides of any electrical junction boxes.

.3 Spray over wall protrusions with polyurethane foam in order to reduce thermal bridges.

.4 Spray over transition membrane to ensure air barrier continuity.

.3 Surface longer than 15 m in either direction: Apply the first layer of foam in 3 m strips at 1 m intervals. After the curing period has elapsed, apply foam into the unfilled spaces.

.4 Avoid spraying the foam on any surfaces other than those indicated. Use drop sheets or masking tape to protect other surfaces.

.5 Once the foam has hardened, remove all overspray from nonprescribed surfaces while at the same time trying not to damage them.

.6 Protect applied work from damage during work by the other Sections.

3.4 Inspection and Testing

.1 Carry out tests required by authorities having jurisdiction.

3.5 Repairs

.1 Where installed materials is found not to meet performance criteria, remove material and replace with new material to meet specified criteria.

.2 Patch areas where samples have been taken for testing. Match materials and application of adjacent work.

END OF SECTION

METAL CLADDING

1. GENERAL

1.1 Performance Requirements

.1 Expansion and Contraction: Design work to accommodate expansion and contraction within design temperature range.

.2 Design Wind and Temperatures: In accordance with requirements of the National Building Code of Canada.

.3 Deflection: Maximum L/240 of clear span at design loads.

.4 Design work to maintain profile specified.

1.2 Quality Assurance

.1 Installer: Trained and approved by the Manufacturer and having a minimum five (5) years experience in the installation of the work described in this Section and can show evidence of satisfactory completion of projects of similar size, scope and type. If requested, provide letter of certification from Manufacturer stating that installer is certified applicator of its products, and is familiar with proper procedures and installation requirements required by the Manufacturer.

.2 Pre-Installation Meeting: Two (2) weeks prior to commencing work of this Section, arrange for Manufacturer's Representative to visit the Site and review preparatory and installation procedures to be followed, conditions under which the work will be done, and inspect the surfaces to receive the work of this Section. Advise the Contract Administrator of the date and time of the meeting.

.3 Manufacturer’s Site Inspection: Have the Manufacturer’s Representative inspect the Work at suitable intervals during application and at conclusion of the work of this Section, to ensure the Work is correctly installed. When requested, submit Manufacturer’s inspection reports and verification that the work of this Section is correctly installed.

.4 Source Limitations: Obtain each type of product from a single manufacturer.

1.3 Submittals

.1 Submit Shop Drawings in accordance with Section 01300 – Submittals.

.2 Samples: Duplicate 50 mm x 75 mm (2” x 3”) samples of cladding material, of colour and profile specified.

.3 Shop Drawings: Clearly indicate type of metal cladding being supplied, surface finish, type and thickness of insulation, thicknesses of metal cladding components, size, spacing and location of structural supports, Z bars and sub-girts, connections, types and locations of

fastenings. Indicate provisions for structural and thermal movement between metal cladding and adjacent materials.

2. PRODUCTS

2.1 Materials

.1 Roll Formed Metal Cladding Panel: Sheet steel coil coated to ASTM A755, galvanized by the hot dip process to ASTM A653M, Z275. Prefinish sheet to meet or exceed requirements of Baycoat Metallic Series. Colour later selected by Contract Administrator not necessarily from Manufacturer's standard offering; apply colours on top side only. AD300 by VicWest.

.2 Aluminium Plate Banding and Soffit Panels: Prefinished, plate aluminium alloy 3105-H14 or 3003-H14, minimum 3.2 mm nominal thickness, reinforced, corners welded and ground smooth, supported with mill finished extruded aluminium rails. Prefinish exposed to view aluminium surfaces in high performance fluoropolymer metallic finish.

.1 High performance fluoropolymer finish: AA-C12C40R1x, chemical finish: cleaned with inhibited chemicals; chemical finish: conversion coatings; organic coating: manufacturer's standard three coat, thermocured system consisting of specially formulated inhibitive primer, fluoropolymer color coat, and clear fluoropolymer topcoat, with both colour coat and clear topcoat containing not less than 70% polyvinylidene fluoride resin by weight. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with AAMA 2605 and with coating and resin manufacturers' written instructions.

.3 Flashings, Trims and Closures: Steel core thickness and finish to match siding. Inside corners, outside corners, cap strip, drip cap, undersill trim, starter strip and window/door trim of same material and colour as cladding, with fastener holes pre-punched.

.4 Girts, Z members, Clips and Brackets: Type 304 stainless steel thickness to meet design requirements.

.5 Fasteners: Non-corrosive concealed fasteners of stainless steel, aluminum or cadmium plated steel, as recommended by the manufacturer. Where exposed fasteners are required, provide fasteners in colours matching cladding work.

.6 Sealant: CAN/CGSB-19.24, Dymeric by Tremco Ltd. or other approved equal.

.7 Backer rod: Non-absorbent, non-gassing, closed cell polyolefin foam, over sized 25%.

2.2 Fabrication

.1 Co-ordinate and verify at Site dimensions affecting work of this Section. Ensure suitability of adjacent building components in relation to work of this Section.

.2 Accurately fit joints and intersecting members to true planes, adequately and securely fastened. Component fastening devices shall be of adequate strength and concealed, except as specified otherwise.

.3 Fabricate work to profiles and sizes indicated complete with rabbets, interlocks, flashings, cappings, trim, filler sections as required to interface with work of other Sections. Make provisions for thermal and structural movements.

.4 Fabricate all devices required for erection and adequate anchorage and attachment required to be built into or attached to substrate and framing members for proper support.

.5 Accurately cut and form flashing true and straight without waves or buckles. Make adequate provision for thermal movement and make joints good.

.6 Reinforce work to meet specified requirements and prevent undue deflection. Supply and install concealed corrosion resistant fastening and continuous formed prefinished cleats.

3. EXECUTION

3.1 Installation - General

.1 Install girts and other members required to support work of this Section except as otherwise shown on Drawings.

.2 Install work in accordance with Manufacturer's written instructions, plumb with intersecting parts joined together to provide tight, accurately fitted joints with adjoining surfaces in true planes. Attach components in manner not restricting thermal movement.

3.2 Installation

.1 Fasten Z members, girts, and rails to structural supports with self-tapping screws at 300 mm centres and to suit loading requirements.

.2 Fasten cladding to supporting members with concealed fasteners where possible and at spacings to suit loading requirements. Ensure complete nesting of cladding on supports.

.3 Align units end-to-end to provide accurate fit with corresponding sections parallel and straight. Keep exposed fasteners to a minimum. Maintain minimum end overlap of 50 mm (2”) and locate directly over supports.

.4 Install aluminium soffit and banding as indicated.

3.3 Installation - Flashing, Closure, Trim And Accessories

.1 Cut and flash openings for louvres, doors, windows and the like. Provide all necessary closures, flashings, drips and trims, sealed to stop direct weather penetration.

3.4 Sealing

.1 Seal junctions with adjoining work with sealant. Apply and cure sealant in accordance with Manufacturer's instructions.

.2 Use backer rod to maintain correct sealant width/depth ratio as recommended by the sealant Manufacturer.

.3 Apply sealant in continuous beads, using gun with proper size nozzle and sufficient pressure to fill voids and joints solid.

.4 Form surface of sealant with full bead, smooth, free from ridges, wrinkles, sags, air pockets, embedded impurities.

.5 Tool exposed surfaces to give slightly concave shape.

END OF SECTION

SBS MODIFIED BITUMINOUS ROOFING

1. GENERAL

1.1 System Description

.1 Concrete Deck: 2 ply SBS modified bituminous sheet roofing work, including but not limited to following:

.1 Concrete deck.

.2 Vapour barrier.

.3 Roof insulation.

.4 Tapered insulation

.5 Insulation overlay.

.6 Base sheet membrane.

.7 Cap sheet membrane.

.8 Base and cap sheet flashings.

1.2 Submittals

.1 Submit Shop Drawings in accordance with Section 01300 – Submittals.

.2 Shop Drawings: Reviewed and signed by Manufacturer's Representative, showing method of installation and layout of each layer, fastening and flashings at edges, flashing of protrusions and penetrations, connection to air barrier in wall, details of insulation, tapered insulation layouts and vapour barrier.

.3 Maintenance Data: Provide necessary maintenance data and repair instructions, recommendations for periodic inspections, care and maintenance. Identify common causes of damage with instructions for temporary patching until permanent repair can be made.

1.3 Quality Assurance

.1 Perform work using skilled and experienced roofing mechanics fully conversant with standards, methods and techniques required for installation of roofing system specified herein. Ensure roofer is qualified and approved by membrane Manufacturer.

.2 Conform to CRCA Specification Manual as amended to date of this Specification, as applicable, except where indicated or specified otherwise.

.3 Pre-installation meeting: Two (2) weeks prior to commencing work of this Section, arrange for Manufacturer's technical representative to visit the Site and review preparatory and

installation procedures to be followed, conditions under which the work will be done, and inspect the surfaces to receive the work of this Section. Advise the Contract Administrator of the date and time of the meeting.

.4 Manufacturer's site inspection: Have the Manufacturer's Representative inspect the Work at suitable intervals during application and at conclusion of the work of this Section, to ensure the Work is correctly installed. When requested, submit manufacturer's inspection reports and verification that the work of this Section is correctly installed.

1.4 Delivery, Storage And Handling

.1 Deliver and store materials in dry location, in original containers with Manufacturer's wrappers and seals intact.

.2 Keep membrane materials dry, stored in rolls standing on end, selvage edge up, elevated from contact with moisture, at temperatures not less than 5°C or more than 49°C. Handle rolls with care to avoid crushing, puncturing or other damage. Ensure selvage edge is not damaged during handling and banding strips are removed before application of membrane. Do not use wet or damp membrane.

.3 Do not expose insulation and sheathing to wet weather. Store and handle insulation to prevent broken edges and corners, punctures, indentations or other damage. Remove damaged insulation from Site.

.4 Protect sheet metal materials from bending and scratching.

.5 Store adhesive, sealants and primers between 15°C and 26°C, or restore to temperature ranges before use.

.6 Store combustible materials away from heat and open flames.

2. PRODUCTS

2.1 Materials - Roof And Flashing

.1 Roofing and Flashing Base Sheet Membrane: CGSB 37-GP-56M, Type 2, Class C, Grade 1 or 2, minimum 3.0 mm ($^1/_8$") thick, non-woven polyester reinforcement and thermofusible elastomeric asphalt, thermofusible plastic film top and bottom face, applied by torching only, Sopralene Flam 180 by Soprema Waterproofing Inc., ModifiedPlus NP180P/P by Bakor Inc., or Torchflex TP-180-FF-Base by IKO Industries Ltd.

.2 Roofing and Flashing Cap Sheet Membrane: CGSB 37-GP-56M, Type 1, Class A, Grade 2, minimum 3.5 mm (0.138") thick, non-woven 250 g/m^2 polyester reinforcement and thermofusible elastomeric asphalt, coloured ceramic or mineral granules top face and thermofusible plastic film bottom face, applied by torching only, Sopralene Flam 250Gr by Soprema Waterproofing Inc., ModifiedPlus NP250gT4 by Bakor Inc., or Torchflex TP-250-Cap by IKO Industries Ltd. Standard colour ceramic or mineral granules.

2.2 Materials - Insulation

.1 Roof Insulation: CAN/ULC S-701 Type 3, expanded, extruded polystyrene board insulation, ship lapped edges, unfaced, Deckmate by Dow Chemical Canada Inc.

.2 Tapered Insulation: CAN/ULC S701, Type 2; CFC and HCFC free, unfaced expanded polystyrene insulation, maximum length and width, square edge, taper cut to provide slopes indicated, on computer controlled machine and sequence packed with detailed installation instruction, minimum 13 mm(0.5") thick.

.3 Insulation Overlay: 6 mm ($^1/_4$") thick board, mineral filled asphalt core between glass fibre facers, Re-Cover Board by Bakor, Sopraboard by Soprema or Protectoboard by IKO.

.4 Insulation adhesive: As recommended by insulation Manufacturer.

2.3 Materials – Metal Flashing

.1 Sheet Metal: Minimum 0.49 mm (26 ga) overall thickness, galvanized to ASTM A653 Z275 zinc coating, commercial quality sheet, stretcher levelled or temper rolled to stretcher level standard of flatness. Prepaint work in Baycoat Metallic series, colour to match metal cladding.

.2 Aluminium Flashing And Trim Sheet Metal: Prefinished aluminium, 0.8 mm base metal thickness, colour to match metal cladding.

.3 Cleats and Starter Strips: Same as specified sheet metal, unless indicated otherwise, make cleats at least 38 mm (1-1/2") wide and interlocked with metal flashing.

.4 Flashing Fasteners: CSA B111 Table 12, finished to match metal being fastened where exposed to view. Size and type to suit requirements.

.5 Sealant: CAN/CGSB-19.13-M, Class M-2-25-B-N, one component polyurethane, or manufacturer's approved products.

2.4 Materials - Accessories

.1 Asphalt primer: CGSB 37-GP-9Ma or as approved by Manufacturer.

.2 Asphalt: CSA A123.4-M; Type 2 or Type 3.

.3 Vapour Retarder: CSA A123.3-M, No. 15 perforated, organic type felt.

.4 Roof Access Hatch: Prefabricated hatch, aluminium construction , 914 mm x 914 mm, complete with insulated curb, integral flashing, heavy pintle hinges, compression spring operators positive snap latch with turn handles inside and outside, padlock hasp and neoprene draft seals; equip cover with automatic hold-open arm and vinyl grip handle. Bilco Type E-50 by Bilco Canada.

3. EXECUTION

3.1 Inspection

.1 Report any defects or irregularities in roof deck detrimental to roof application. Do not proceed until corrected.

.2 Allow concrete deck to cure for minimum thirty (30) calender days before placement of any roofing materials.

.3 Check deck is properly installed in compliance with latest CRCA recommendations and specifications, with required slopes to attain positive drainage.

.4 Ensure openings, walls and projections through deck are completed and affixed and reglets and nailing strips are in place prior to membrane installation. Cooperate with mechanical and/or electrical divisions as necessary.

.5 Ensure deck substrate scheduled to receive roof system is smooth, dry, clean and free of sharp projections.

3.2 Preparation

.1 Sweep roof surfaces clean, remove debris, water, dew, frost, snow, ice and foreign materials (oil/grease) which could impair work.

.2 Do not use salt or calcium to remove ice or snow.

.3 Do no roofing work during rain, fog, sleet or snow, or upon surfaces covered with dust, water, dew, ice, frost, snow and similar detrimental conditions.

3.3 Protection

.1 Protect adjacent work, building and property, existing and completed portion of roof, from damage during roofing operations.

.2 Hang tarpaulins to protect walls where hoisting is necessary. Locate kettles so smoke will not discolour building or adjacent buildings or enter air intakes. Keep masonry and finished surfaces clean and free of bitumen.

.3 Use wood planks or minimum 9 mm ($^{3}/_{8}$") thick plywood sheathing in work areas and along work routes as required to prevent damage to steel deck, or sheathing and roofing.

.4 Keep two foam or dry type fire extinguishers on roof within easy access of torching application and in any open flame location while roofing is in progress.

.5 Verify no vent pipes venting flammable fumes (i.e. fuel storage tanks) are located in area of work.

.6 Do not have gasoline or other flammable solvents on roof while torching.

.7 Install temporary blocking and/or otherwise protect drains during roofing operations. Remove at completion of roofing work.

.8 At conclusion of each day's work, seal exposed edges of roof insulation. Remove when resuming work.

.9 Do not torch over or near flammable substrates such as fibreboard.

3.4 Cold Weather Application

.1 Remove moisture from substrate before application of membrane.

.2 Daily weather forecasts shall be followed to determine commencement of work or to anticipate possible suspension.

.3 At temperatures below 10°C, store membrane material in warm and dry storage until ready to use. Bring out to work area only enough rolls for immediate use.

.4 Unroll membrane and allow roll to relax in sunlight for 30 to 45 minutes before application. Reroll from both ends and apply in both directions.

.5 Maintain mopping temperatures of asphalt at minimum 204°C. Limit mop strokes to 1200 mm (48") ahead of roll.

.6 Before starting mop stroke, pull roll tightly against cooled asphalt, so as to eliminate any air pockets or voids that may have occurred during previous mop stroke.

3.5 Installation

.1 General: Use only roofing equipment approved by Manufacturer of roofing membrane system.

3.6 Installation - Primer

.1 Prime concrete deck with asphalt primer in manner approved by primer Manufacturer, at minimum rate of 0.50 l/m^2 (1 gal/300 ft^2).

.2 Apply primer to surfaces to which membrane or vapour barrier shall be adhered to directly. Allow primer to cure. Do not allow ponding.

3.7 Bitumen

.1 Heat asphalt in accordance with manufacturer's directions. Never heat asphalt to or above Flash Point (FP) indicated by manufacturer, but in any case do not heat asphalt to or above 260°C.

.2 Do not apply at temperature lower than EVT (Equiviscous Temperature). Restrain asphalt temperature at point of application to EVT plus/minus 15°C.

.3 Do not heat and hold asphalt above Finish Blowing Temperature (FBT) for more than four (4) hours.

.4 Use heating kettles equipped with thermometers which continually show temperature of asphalt. Equip foreman with portable stem thermometer for checking temperature at point of application.

.5 Roofing Asphalt: Type 2 for slopes up to 1:16 and Type 3 for slopes greater than 1:16.

3.8 Vapour Retarder

.1 General: Install vapour retarder full coverage and continuously overlapped and sealed to adjacent air/vapour barrier at top of parapets and curbs to ensure continuity of building envelope.

.2 Mop prime deck with uniform and continuous coating of asphalt. Roll felt in hot mopped asphalt, lapping each sheet 480 mm (19") over preceding sheet and mopping full 480 mm (19") under each lap leaving no area unmopped. Use 1.2 kg/m^2 (25 lb/sq) of asphalt per ply. Seal lap joints.

3.9 Installation - Insulation

.1 Before laying any insulation, inspect vapour barrier and repair damage, if any. Ensure surface is free of wrinkles, air pockets, fishmouths or tears.

.2 Over vapour barrier apply full mopping of asphalt at minimum rate of 1.0 kg/m^2 (20 lb/sq) and embed insulation.

.3 Lay roof insulation in hot asphalt. Bring each board into moderate contact with adjacent boards and do not force into place.

.4 Cover entire area of base insulation with tapered insulation. Lay in accordance with Manufacturer of tapered insulation's shop drawings, with joints staggered from insulation joints. Lay each layer in full mopping of hot asphalt. Tape joints in top layer of insulation.

.5 Cover entire area of tapered insulation with overlayment. Stagger joints of lower overlayment to those of tapered insulation. Stagger joints upper overlayment to those of lower overlayment. Lay work in full mopping of asphalt.

.6 Where insulation and overlayment abut irregular surface, scribe to profile thereof, elsewhere cut insulation square and neatly to provide plain butt joints at perimeter of insulation, at curbs and other vertical objects and surfaces.

.7 Lay only as much roof insulation and overlayment that can be covered on same day with roofing membrane. At conclusion of day's work, seal exposed edges. Upon resumption of work, cut and remove sealed edges, square, neat and straight.

.8 Reduce thickness of insulation at drains by 13 mm (0.5") for 1200 mm (48") square centred on each drain to ensure free flow to drain.

.9 Keep insulation, tapered insulation and insulation overlay dry at all times.

3.10 Base Sheet Membrane

.1 Ensure membrane substrate is rigid, dry, smooth, compatible, free of fins and sharp edges, and clean of debris and foreign matter and no moisture is present on substrate at time of application of membrane.

.2 Start roofing application at lowest point of roof (edge or drain) to ensure water flows over laps of membrane. Proceed up slope at right angles to direction of flow.

.3 Position and unroll membrane to achieve correct overlap and alignment with roof line. Re-roll one end minimum 3000 mm (10') and adhere to substrate. Complete application of remainder of sheet.

.4 Torch weld base sheet membrane by sufficiently heating lower surface of membrane evenly across width of roll to melt lower surface and provide flow of bitumen. At same time unroll roofing membrane into melted bitumen. Keep checking adhesion to be certain asphalt is hot enough. Take care and inspect so heating is even across width to avoid skips or voids.

.5 Lay base sheet with 75 mm (3") side laps and 150 mm (6") end laps.

.6 Flow out bead shall be present at all locations along lap edges. Avoid excessive asphalt seepage. Maximum seepage allowed 6 mm ($^1/_4$").

.7 At walls and vertical surfaces, extend membrane minimum 50 mm (2") on vertical surface and nailed at 300 mm (12") on centres.

3.11 Base Sheet Flashings

.1 Apply base sheet flashing over dried and cured primer coat.

.2 Pre-cut flashing in strips 1 m (39") wide to correct length to extend minimum 100 mm (4") onto field of roof, up vertical surface and over any fascia minimum 50 mm (2"). Side laps shall be 75 mm (3") and staggered minimum of 100 mm (4”) with laps of base sheet. Dry fit pieces to proper size.

.3 Provide base flashing reinforcements at stress points of roof, at inside and outside corners, vents, drains and mechanical units. Install as detailed on Drawings or follow membrane Manufacturer's recommendations.

.4 Provide base flashings at roof protrusions such as vents pipes, roof drains, mechanical equipment curbs. Install as detailed on Drawings.

.5 Torch apply base sheet flashing directly on its support from bottom to top. Torch welding shall soften under side of base sheet without overheating, resulting in uniform adhesion over entire surface. Take precaution not to stretch membrane. When allowed by support, nail top edge of base sheet flashing 300 mm (12") oc.

3.12 Cap Sheet Membrane

.1 Do not apply cap sheet until base sheet and flashing have been applied and show no sign of defects.

.2 Plan cap sheet application so side and end laps are offset from those of base sheet minimum 300 mm (12") for side and 450 mm (18") for end laps. Mark chalk line, centred on base sheets, where first course is to start. Unroll 2 m to 3 m (6' to 9') of membrane and line it up to chalk lines or to selvage edge. If roll goes out of line by more than 13 mm (0.5"), cut and re-align. Re-roll from both ends and apply in both directions.

.3 Lay cap sheet with 75 mm (3") side laps to cover selvage edge and 150 mm (6") end laps.

.4 Commence application of cap sheet with 1 m (39") square of cap sheet centred on each drain and torched down.

.5 Apply one ply of cap sheet granule side up. Position and unroll cap sheet to achieve correct overlap and alignment. Re-roll one end minimum 3000 mm (10') and adhere to substrate. Complete application of remainder of sheet. Torch weld by sufficiently heating lower surface of membrane evenly across width of roll to melt lower surface and provide flow of bitumen. At same time unroll roofing membrane into melted bitumen. Keep checking adhesion to be certain asphalt is hot enough. Take care and inspect so heating is even across width to avoid skips or voids. Install cap sheet in same direction as base sheet.

.6 Flow out bead shall be present at all locations along lap edges. Avoid excessive asphalt seepage. Maximum seepage allowed 6 mm ($^1/_4$").

.7 Take great care to ensure asphalt does not spread out over exposed part of cap sheet.

.8 Factory provided granules shall be applied to overflow bitumen at lap before bitumen cools to provide clean appearance.

.9 Bevel "T" joints at end or head laps and repair fishmouths using torch heated trowel.

.10 Cut out drain opening after drain clamps have been installed.

3.13 Cap Sheet Flashings

.1 Pre-cut flashing in strips 1 m (39") wide to correct length to extend minimum 150 mm (6") onto field of roof, up vertical surface and over any fascia minimum 50 mm (2"). Side laps

shall be 75 mm (3") and staggered minimum of 100 mm (4") with laps of base sheet. Dry fit pieces to proper size.

.2 Using chalk line, lay out straight line on cap sheet surface, parallel to roof edge, 150 mm (6") inside roof from parapet wall.

.3 Soften bitumen by heating mineral surface with torch. When granules start to sink into bitumen, stop torching with hot round nosed trowel, embed granules in bitumen from chalk line to edge of cap sheet.

.4 Torch apply cap sheet completely covering base sheet, lapping edges to selvage. Torch welding shall soften under side of base sheet without overheating, resulting in uniform adhesion over entire surface. Press in firmly for proper adhesion. Continue by bonding upper portion to wall, taking precautions not to stretch membrane.

.5 Anchor, with tin capped nails or roofing nails and disks or membrane Manufacturer's recommended fasteners placed at top of flashing and driven into wood backing.

.6 Flow out bead shall be present at all locations along lap edges. Avoid excessive asphalt seepage. Maximum seepage allowed 6 mm ($^1/_4$").

.7 Take great care to ensure asphalt does not spread out over exposed part of cap sheet flashing.

.8 Factory provided granules shall be applied to overflow bitumen at lap before bitumen cools to provide clean appearance.

3.14 Sheet Metal Work

.1 Do not install metal flashings until membrane flashings have been reviewed by Contract Administrator.

.2 Take delivery of pre-painted flashings supplied by others.

.3 Prime metal flashings with asphalt primer.

.4 Double back exposed edges at least 13 mm (0.5") for appearance and stiffness.

.5 Provide continuous starter strips to present true, leading edge. Anchor to backup to provide rigid, secure installation. Conceal fastening.

.6 Counterflash modified bitumen flashings as indicated. Dovetail, mitre corners.

.7 Use slip expansion seams. Make joints to permit thermal movement. Make surfaces free from buckling, warp, wave, dents, oil canning or other defects. Make corners square and surfaces straight and in true planes. Equally space joints in any one run of flashing to suit building module or window spacing and in all cases locate in consultation with Contract Administrator before installation commences. Space seams 2400 mm (8') oc maximum or closer if indicated.

.8 Obtain Contract Administrator's approval of exposed fastenings. If exposed screws or bolts are used, use lead or neoprene washers with them.

.9 Close lock seams gently with wood block and mallet, apply sealant to joints.

3.15 Roof Access Hatch

.1 Install and flash roof access hatch in position indicated, in accordance with Manufacturer's directions for secure, watertight installation.

3.16 Field Quality Control

.1 Inspection: the City may engage independent inspection company to inspect work of this Section. Give at least two (2) weeks notice of starting work and allow inspector free access. Inspection may include thermographic survey of completed roof.

3.17 Extended Warranty

.1 Provide membrane manufacturer's ten year non-prorated material, labour and workmanship warranty, commencing from date of Substantial Performance, covering defects and deficiencies and weathertightness of complete roof and flashing system.

END OF SECTION

EPDM WATERPROOF MEMBRANE

1. GENERAL

1.1 Work Included

.1 Supply and installation of EPDM membrane around the Surge Tower portions below grade to extents shown on the Drawings including the following major items of Work:

.1 Wall and footing membrane

.2 Polyethylene slip sheets and protection board at perimeter of walls to be backfilled

.3 Insulation

1.2 Storage and Handling

.1 Provide and maintain dry, off-ground weatherproof storage.

.2 Store materials on supports to prevent deformation.

.3 Remove from storage only in quantities required for same day use.

.4 Store uncured flashing and jointing materials to prevent premature curing or freezing.

.5 Store materials in accordance with Manufacturer's written instructions.

1.3 Environmental Requirements

.1 Do not proceed with Work when wind chill effect would tend to set bitumen before proper curing takes place.

.2 Maintain air temperature and substrate temperature at membrane installation area above 5°C for twenty four (24) hours before, during, and twenty four (24) hours after installation, or as recommended by the Manufacturer.

.3 Do not apply membrane in wet weather.

1.4 Shop Drawings

.1 Submit Shop Drawings in accordance with Section 01300 – Submittals.

.2 Shop Drawings shall indicate material and membrane sheet joint layout.

1.5 Mock-Up

.1 The first portion of membrane installation, which shall include a typical lap joint, intersection with walls, insulation, protection board, and slip sheet, will be considered as the mock-up and, when accepted, will form part of the completed Work.

.2 Provide at least twenty four (24) hours notice prior to start of membrane installation Work.

.3 Arrange for membrane Manufacturer's Representative to be On-Site during start up procedures and periodically during progress of the Work to ensure installation is in accordance with Manufacturer's instructions and requirements.

1.6 Qualifications

.1 The Contractor shall provide documentation showing the installation Subcontractor to be a membrane material roofing applicator approved by the membrane Manufacturer.

.2 Work is to be performed in accordance with elastomeric membrane Manufacturer's printed application instructions unless specified otherwise.

2. PRODUCTS

2.1 Materials

.1 EPDM Membrane

.1 EPDM membrane shall be felt-backed EPDM synthetic rubber waterproofing membrane applied with hot rubberized asphalt for the walls and footings. Membrane shall be Lexcan Design D, 1.5 mm thick felt-backed membrane or accepted alternate.

.2 Splice cleaner, adhesive, tape, and sealant shall conform to the membrane Manufacturer's recommendations.

.3 Asphalt for wall application shall conform to 7204 Insul-Stik Adhesive by Insulmastic Building Products or accepted alternate.

.4 Membrane material shall conform without exception to the performance characteristics shown on Table 1 attached to this Section.

.2 Polystyrene Insulation: polystyrene insulation shall conform to Type 4, 100 mm in thickness, shiplapped edges, and minimum compressive strength of 240 kPa, Foamular 400 by Owens Corning, or accepted alternate.

.3 Polyethylene Slip-Sheet: polyethylene Slip-Sheet shall conform to CAN2-51.34, Type 1, 0.25 mm thick.

.4 Protection Board: protection board shall be Type 2 fibreboard as accepted by the Contract Administrator.

3. EXECUTION

3.1 Substrate Examination

.1 Prior to commencement of Work ensure substrates are firm, straight, smooth, dry, free of snow, ice, or frost, and swept clean of dust and debris.

3.2 Protection

.1 At end of each day's Work or when stoppage occurs due to inclement weather, provide protection for completed Work and materials out of storage.

.2 Seal and secure exposed edges.

3.3 Membrane Application

.1 General

.1 Do not install EPDM membrane when air and substrate temperature remains below 5°C in accordance with Manufacturer's recommendations or when wind chill gives equivalent cooling effect.

.2 Install EPDM membrane on clean dry substrate, free of snow and ice. Use only dry materials and apply only during weather that will not introduce moisture into the system.

.3 Ensure that temperature of substrate and its moisture content conforms to Manufacturer's minimum requirements, before proceeding with Work.

.4 Membrane shall be installed only after successful watertightness testing of the concrete water retaining structure.

.2 Positioning Membrane Sheets

.1 Ensure substrate is clean, flat, and free from dirt, debris, and sharp projections that might be detrimental to the performance of the membrane.

.2 Unroll membrane sheets and position according to accepted Shop Drawings, ensuring a tight butt-edge with adjacent sheets. Do not over-lap sheets.

.3 Bonding to Substrate

.1 Apply specified asphalt base by trowel in accordance with the Manufacturer's instructions to achieve coverage of a minimum of 1.0 kg of material per square metre. Limit application to the applied roll width of EPDM membrane.

.2 While the asphalt is still in an adhesive state, roll the membrane into asphalt, avoiding air bubbles or wrinkles (refer to flash cure set period from Manufacturer's product information). Brush down on the membrane with a push broom to achieve maximum contact. Ensure proper alignment at butt seam joints.

.3 Leave a minimum of 500 mm of unbonded membrane at the top of the membrane application for incorporation into the structure envelope wall assembly.

.4 Splicing Membrane Sheets

.1 Clean a 20 cm wide strip of EPDM membrane with Seam Cleaner. Ensure any asphalt spills are scraped off. Apply a 20 cm wide strip of splice adhesive to the membrane, centred over the seam. Apply with a paint brush using straight painting strokes (not a circular motion). Allow adhesive to dry until it is tacky, but does not stick to a dry finger touch.

.2 Remove paper backing and apply Overlay Seam Tape to the membrane, centred lengthwise over the seam. Overlap tape ends and "T" junctions a minimum of 10 cm. Roll tape heavily with a steel roller.

.3 Apply 30 cm^2 overlay patches of flashing centred over all seam "T" junctures, seam overlays, and corners. Apply with Splice Adhesive according to adhesive Manufacturer's application instructions.

.4 Caulk both edges of Overlay Seam Tape and all exposed membrane of flashing edges with Lap Sealant. Feather sealant with tool provided.

3.4 Insulation Application

.1 Insulation to be placed in parallel rows with ends staggered.

3.5 Flashing Application

.1 Install cured or uncured EPDM membrane flashings in accordance with Manufacturer's written instructions.

.2 Flash pipes and other penetrations through waterproofing membrane using prefabricated or field fabricated membrane flashings.

3.6 Protection Board and Slip Sheet Application

.1 Install protection board and slip sheet concurrently with backfilling.

3.7 Cleaning

.1 Clean soiled surfaces, spatters, and damage caused by Work of this Section to satisfaction of Contract Administrator.

3.8 Guarantees

.1 The membrane Manufacturer shall provide a prorated written guarantee against manufacturing defects in the membrane materials for a period of twenty (20) years from the date of Total Performance. The Manufacturer shall complete and sign the enclosed Form W1: Manufacture Guarantee Agreement (attached to this Section) upon Award of Contract. The Manufacturer shall indicate his written approval in Form W1 of the selected Subcontractor for the installation of the membrane system.

.2 The Subcontractor shall provide a written guarantee stating that the membrane system will provide leak-free service for a period of five (5) years from the date of Total Performance.

The Subcontractor shall complete and sign the enclosed Form W2: Subcontractor Guarantee Agreement (attached to this Section) upon Award of Contract.

END OF SECTION

Table 1: Required Membrane Characteristics

PROPERTY	ASTM TEST	REQUIREMENTS	YES	NO
Thickness	D751	± 10%		
Breaking Strength, minimum	D751	14.0 kN/m		
Elongation @ Fabric Break	D751	80%		
Elongation @ Rubber Break	D751	350%		
Elongation, Ultimate	D421	400%		
Tearing Resistance, minimum	D624, DIEC	35.0 kN/m		
Tongue Tear Strength, minimum	D751	156 N		
Brittleness Point, maximum	D2137	-60˚C		
Ozone Resistance (7 days @ 100 pphm, 20% elong 40^{o}C)	D1149	No cracks @7 x mag		
Water Absorption, maximum	D471	+ 1%		
Factory Seam Strength	D816	9.6 kN/m		
Breaking Strength, minimum	D751	7.5 kN/m		
Elongation @ Rubber Break	D751	250%		
Elongation, Ultimate	D421	250%		
Tearing Resistance, minimum	D624, DIEC	30.6 kN/m		
Tongue Tear Strength, minimum	D751	111 N		
Linear Dimensional Change, maximum	D1204	±1%		

Form W1: Manufacture Guarantee Agreement

Sheet 1 of 2

SURGE TOWER MEMBRANE SYSTEM

GUARANTEE TO THE CITY OF WINNIPEG

FOR PROJECT:

WATER TREATMENT PROGRAM – SURGE TOWER CONSTRUCTION

BID OPPORTUNITY NO. 37-2006

Manufacture's Name and Address

does hereby provide, in accordance with the Specifications of the Contract, the following Guarantee for the herein identified Surge Tower Membrane System.

The EPDM membrane material is guaranteed against the following defects attributable to defective material for a period of twenty (20) years from the date of issue of the Certificate of Total Performance of the membrane system:

1. Premature deterioration in forms of cracking, brittleness, loss of elongation characteristics, tearing resistance, water absorption qualities to the point of failure under the effects of historical climatic conditions.

2. The membrane system shall be defined as membrane, rubberized asphalt, flashing, tapes, adhesives, sealant, and joint reinforcement membrane strips and any other products required for use in the membrane system.

3. Material failure shall be defined as any defects that results in the loss of leak free performance during the guarantee period.

Remedial works covered by this guarantee shall include the repair or replacement of the defective membrane area. The cost of removal and replacement of material above or adjacent to the membrane is not included in this guarantee.

All remedial works shall carry a minimum twenty (20) year guarantee as stipulated above.

Form W1: Manufacturer Guarantee Agreement

Sheet 2 of 2

MANUFACTURER APPROVAL OF SELECTED APPLICATOR

We, the Manufacturer, approve the selection of _____ as the membrane material applicator of our wall membrane system.

MANUFACTURER

Name of Company Officer	Corporate Position	Signature of Company Officer
Name of Witness	Signature of Witness	Date

CONTRACTOR

Name of Company Officer	Corporate Position	Signature of Company Officer
Name of Witness	Signature of Witness	Date

Form W2: Subcontractor Guarantee Agreement

Sheet 1 of 1

SURGE TOWER MEMBRANE SYSTEM

GUARANTEE TO THE CITY OF WINNIPEG

FOR PROJECT:

WATER TREATMENT PROGRAM – SURGE TOWER CONSTRUCTION

BID OPPORTUNITY NO. 37-2006

Subcontractor's Name and Address

does hereby provide, in accordance with the Specifications of the Contract, the following Guarantee for the herein identified Surge Tower Membrane System.

The Membrane System is guaranteed against the following defects attributable to faulty installation for a period of five (5) years from the date of issue of the Certificate of Total Performance with respect to the membrane system:

1. Leak free performance of the membrane system. The membrane system shall be defined as membrane, rubberized asphalt, flashing, tapes, adhesives, sealant, and joint reinforcement membrane strips and any other products recommended by the Manufacturer for use in the membrane system.
2. Debonding of the EPDM sheet membrane material from the wall and foundation construction.

Remedial works covered by this guarantee shall include the repair or replacement of the defective membrane area. The cost of removal and replacement of material above or adjacent to the membrane is not included in this guarantee.

All remedial works shall carry a minimum five (5) year guarantee as stipulated above.

SUBCONTRACTOR (Applicator)

Name of Company Officer	Corporate Position	Signature of Company Officer
Name of Witness	Signature of Witness	Date

CONTRACTOR

Name of Company Officer	Corporate Position	Signature of Company Officer
Name of Witness	Signature of Witness	Date

JOINT SEALANTS

GENERAL

1.1 General Requirements

.1 This Section specifies sealing work not specified in other Sections. Refer to other Sections for the respective sealant work.

1.2 Submittals

.1 Submit Shop Drawings in accordance with Section 01300 – Submittals.

.2 Samples for Initial Selection: Provide 150 mm (6”) long cured, colour samples of Manufacturer's standard range of colours in each type of sealant for selection by Contract Administrator. Submit samples of primer, bond breaker tape and joint backing material, if requested.

.3 Product Data: Submit product information from sealant Manufacturers prior to commencement of work of this Section verifying:

.1 Selected sealant materials are from those specified

.2 Composition and physical characteristics

.3 Surface preparation requirements

.4 Priming and application procedures

.5 Suitability of sealants for purposes intended and joint design

.6 Test report on adhesion, compatibility and staining effect on samples of materials used on Project

.7 Sealants compatibility with other materials and products with which they come in contact including but not limited to sealants provided under other Sections, insulation adhesives, bitumens, brick, stone, concrete, masonry, metals and metal finishes, ceramic tile, plastic laminates, paints

.8 Suitability of sealants for temperature and humidity conditions at time of application

1.3 Quality Assurance

.1 Installer: Trained and approved by the Manufacturer and having a minimum three (3) years experience in the installation of the work described in this Section and can show evidence of satisfactory completion of projects of similar size, scope and type. If requested, provide letter of certification from Manufacturer stating that installer is certified applicator of its products, and is familiar with proper procedures and installation requirements required by the Manufacturer.

.2 Manufacturer's Site Inspection: Have the Manufacturer's Representative inspect the Work at suitable intervals during application and at conclusion of the Work of this Section, to ensure the Work is correctly installed. When requested, submit Manufacturer's inspection reports and verification that the work of this Section is correctly installed.

.3 Pre-Installation Meeting: Ten (10) business days prior to commencing Work of this Section, arrange for Manufacturer's Representative to visit the site and review preparatory and installation procedures to be followed, conditions under which the Work will be done, and inspect the surfaces to receive the work of this Section. Advise the Contract Administrator of the date and time of the meeting.

.1 Weather conditions under which work will be done

.2 Anticipated frequency and extent of joint movement

.3 Joint design

.4 Suitability of durometer hardness and other properties of material to be used

.5 Recommendations of manufacturer for mixing of multi-component sealants

.6 Number of beads to be used in sealing operation and priming operation if required

1.4 Delivery, Storage and Handling

.1 Deliver materials in original, unopened containers with manufacturers labels identifying Manufacturer's name, brand name of product, grade and type, application directions and shelf life or expiry date of product.

.2 Handle and store materials in accordance with Manufacturer's printed directions. Store flammable materials in safe, approved containers to eliminate fire hazards.

.3 Do not use sealing materials that has been stored beyond the maximum recommended shelf life.

1.5 Project Conditions

.1 Environmental Requirements: Do not apply any sealant under adverse weather conditions, when joints to be sealed are damp, wet or frozen or when at ambient temperatures below 5°C (40°F). Maintain minimum temperature of application during application and for eight (8) hours after application. Consult Manufacturer for specific instructions before proceeding and obtain Contract Administrator's approval.

2. PRODUCTS

2.1 Materials

.1 General: Non-bleeding, non-migrating, capable of supporting their own weight.

.1 Horizontal Joints: Self levelling.

.2 Vertical and Overhead Joints: Non-sag.

.2 Sealant Type A: CAN/CGSB-19.24-M, Type 2, Class B, multi-component, chemical curing, modified polyurethane, Sikaflex 2cNS EZ Mix by Sika, or Dymeric 240 by Tremco.

.3 Joint Backing: Preformed, compressible, resilient, non-waxing, non-extruding, non-staining closed cell polyethylene or urethane foam, shape to suit intended use, oversize 25% and compatible with sealant, primer and substrate.

.4 Bond Breaker Tape: As recommended by sealant manufacturer.

.5 Joint Primer: Non-staining, suitable for substrate surfaces, compatible with joint sealants and as recommended by sealant manufacturer.

.6 Cleaning Material: Non-corrosive, non-staining, xylol, methyl-ethyl-ketone, toluol, isopropyl alcohol or as recommended by sealant manufacturer and acceptable to material or finish manufacturers for surfaces adjacent to sealed areas.

.7 Sealants, Cleaning Materials and Primers: Compatible with each other.

3. EXECUTION

3.1 Examination

.1 Ensure joints are suitable to accept and receive sealants. Commencement of work implies acceptance of surfaces and conditions.

.2 Do not apply sealant to masonry until mortar has cured.

.3 Before any sealing work is commenced, test materials for indications of staining or poor adhesion.

3.2 Preparation

.1 Clean joints and spaces which are to be sealed and ensure they are dry and free of dust, loose mortar, oil, grease, oxidation, coatings, form release agents, sealers and other foreign material.

.2 Clean porous surfaces such as concrete, masonry or stone by wire brushing, grinding or sandblasting as required to obtain clean and sound surfaces.

.1 Remove laitance by grinding or mechanical abrading.

.2 Remove oils by abrasive blast cleaning.

.3 Remove loose particles present or resulting from grinding, abrading or sandblast cleaning by thorough brushing.

.3 Clean ferrous metals of rust, mill scale and foreign materials by wire brushing, grinding or sanding.

.4 Wipe non-porous surfaces such as metal and glass to be sealed, except pre-coated metals, with cellulose sponges or clean rags soaked with ethyl alcohol, ketone solvent, xylol or toluol and wipe dry with clean cloth.

.1 Where joints are to be sealed with silicone based sealants clean joint with methyl-ethyl-ketone or xylol. Do not allow solvent to air-dry without wiping.

.2 Clean pre-coated metals with solutions or compounds which will not injure finish and which are compatible with joint primer and sealant.

.5 Install joint backing material to achieve correct and uniform joint profile.

.6 Where joint design or depth of joint prevents use of joint backing material, apply bond breaker tape to prevent three-sided adhesion.

.7 Do not stretch, twist, puncture or tear joint backing. Butt joint backing at intersections. Install bond breaker tape at back of joint where joint backing is not required or cannot be installed.

.8 On horizontal traffic surfaces, support joint filler against vertical movement which might result from traffic loads, including foot traffic.

.9 Where surfaces adjacent to joints are likely to become coated with sealant during application, mask them prior to priming and sealing.

.10 Do not exceed shelf life and pot life of materials, and installation times, as stated by Manufacturers.

.11 Use materials as received from Manufacturer, without additions, deletions and adulterations of materials.

.12 Mix multiple component sealants and bulk sealants using mechanical mixer capable of mixing without mixing air into material, strictly in accordance with Manufacturer's directions and recommendations. Continue mixing until material is homogeneously blended,

uniform in colour and free from streaks of unmixed material. Install compound prior to start of hardening or curing cycle.

.13 Seal joints in surfaces to be painted before surfaces are painted. Where surfaces to be sealed are prime painted in shop before sealing check to make sure prime paint is compatible with primer and sealant. If they are incompatible, inform Contract Administrator and change primer and sealant to compatible types approved by Contract Administrator.

.14 Where irregular surface or sensitive joint border exists, apply masking tape at edge of joint to ensure joint neatness and protection.

.15 Prime joints as required by sealant manufacturer. Prime sides of joints for type of surface being sealed prior to application of joint backing, bond breaker or sealant.

3.3 Application

.1 Apply sealant using hand operated guns or pressure equipment fitted with suitable nozzle size and equipment approved by sealant manufacturer. Apply in accordance with Manufacturer's directions and recommendations.

.2 Force sealant into joint and against sides of joints to obtain uniform adhesion. Use sufficient pressure to completely fill all voids in joint regardless of variation in joint widths and to proper joint depth as prepared. Ensure full firm contact with interfaces of joint. Superficial pointing with skin bead shall not be acceptable.

.3 Finish face of compound to form smooth, uniform beads. At recesses in angular surfaces, finish compound with flat face, flush with face of materials at each side. At recesses in flush surfaces, finish compound with concave face flush with face of materials at each side.

.4 Compound may be tooled, provided that such tooling does not damage seal or tear compound. Avoid pulling of sealant from sides.

.5 Tool surfaces as soon as possible after sealant application or before any skin formation has occurred, particularly when using silicone sealants.

.6 Joint surfaces shall be straight, neatly finished, free from ridges, wrinkles, sags, dirt, stains, air pockets and embedded foreign matter or other defacement and be uniform in colour, free from marbling and/or colour streaking due to improper mixing or use of out of shelf life products.

3.4 Sealant Schedule

.1 Use one of sealants specified for each type in following locations. Ensure sealant chosen for each location is recommended by manufacturer for use for conditions encountered.

.2 Refer to Drawings for sealing work not specifically listed in this Section.

.3 Seal following joints with Sealant Type A:

.1 Exterior hollow metal steel door frames, both sides.

.2 Joints between thresholds and slabs.

3.5 Repair

.1 Remove any compounds not complying with requirements specified herein. Exercise care in removal operations not to mar or damage finishes adjacent to joints. Repeat preparation, priming and installation of new material as specified to provide finished work complying with specified requirements, and acceptable to Contract Administrator. Do such repair work at the Contractor's cost.

3.6 Cleaning

.1 Immediately clean adjacent surfaces which have been soiled and leave Work in neat, clean condition. Remove excess materials, compounds smears or other soiling resulting from application of sealants. Use recommended cleaners and solvents.

3.7 Protection of Completed Work

.1 Provide approved, non-staining means of protection for completed joint sealant installations where required to protect work from mechanical, thermal, chemical and other damage by construction operations and traffic.

.2 Maintain protection securely in place until completion of Work. Remove protection when so directed by Contract Administrator.

END OF SECTION

STEEL DOORS AND FRAMES

1. GENERAL

1.1 Design Requirements

.1 Design exterior assemblies to accommodate to expansion and contraction when subjected to minimum and maximum surface temperature of -35°C to 35°C.

.2 Install Work to CSDFMA Installation Guide.

1.2 Quality Assurance

.1 Fabrication: Comply with requirements of CSDFMA.

.2 Source Limitations: Obtain doors and frames through one source from a single Manufacturer.

1.3 SUBMITTALS

.1 Shop Drawings: Indicate each type of door and frame, material, steel core thicknesses, mortises, reinforcements, location of exposed fasteners, openings, and arrangement of hardware.

1.4 DELIVERY, STORAGE, AND HANDLING

.1 Brace and protect doors and frames to prevent distortion during shipment. Store in a secure dry location.

.2 Store doors vertically, resting on planks, with blocking between to allow air to circulate.

2. PRODUCTS

2.1 Materials

.1 Metallic Coated Sheet Steel: ASTM A568M Class 1 Commercial grade steel, hot-dip galvanized to ASTM A 653/A653M ZF75/A25 zinc coated (Galvanized) or ZF180/A40 zinc-iron alloy-coated (Galvannealed).

.2 Minimum Core Thickness, without Coating: Metallic Coated Sheet Steel:

.1 Exterior Door Frames: 2.0 mm (0.078”).

.2 Doors, Hollow Steel Construction

.1 Face Sheets: 1.519 mm (0.060”).

.2 Vertical Stiffeners, 0.912 mm (0.036”).

.3 Lock and Strike Reinforcements: 2.66 mm (0.1").

.4 Hinge and Pivot Reinforcements: 3.416 mm (0.134") thick by 38 mm (1.5") wide by 150 mm (6") longer than hinge and pivot, secured by not less than 6 spot welds.

.5 Surface Applied Hardware Reinforcements : 2.66 mm (0.1").

.6 Closer or Holder Reinforcements: 2.66 mm (0.1").

.7 Top and Bottom End Channels and Caps: 1.6 mm (0.060").

.8 Mortar Guard Boxes: 0.759 mm (0.03").

.9 Floor Anchors: 1.6 mm (0.060").

.10 Jamb Spreaders: 0.912 mm (0.036").

.11 Frame Anchors: T-strap type, 1.214 mm (0.048").

.3 Insulation: Fibreglass to CSA A101, semi-rigid.

.4 Adhesives for Steel Components: Heat resistant, spray grade, resin reinforced neoprene/rubber (polychloroprene) based, low viscosity, contact cement.

.5 Touch-up primer: CAN/CGSB-1.181, Zinc rich primer.

.6 Door Silencers: Single stud rubber/neoprene type

.1 Single Door: Three silencers on strike jamb.

.7 Welding: CSA W59-M.

.8 Filler: Metallic paste, manufacturer's standard.

.9 Thermal Break: Rigid PVC extrusion.

2.2 Fabrication - General

.1 Fabricate work in accordance with requirements of CSDFMA.

.2 Blank, reinforce, drill and tap units for mortised, templated hardware, and electronic hardware using templates provided by the hardware suppliers. Reinforce units for surface mounted hardware.

.3 Do welding to CSA W59.

.4 Apply, at factory, touch up primer to doors and frames manufactured from metallic coated steel where coating has been removed during fabrication.

.5 Make provisions in doors and frames to suit requirements of Section providing security devices.

2.3 Fabrication – Frames

.1 Fabricate frames to profiles and maximum face sizes as required to suit design, welded construction.

.2 Cut mitres and joints accurately and weld continuously on inside of frame profile.

.3 Grind welded corners and joints to flat plane, fill with metallic paste filler and sand to uniform smooth finish.

.4 Protect mortised cutouts with mortar guard boxes in masonry and concrete constructions. Conceal fastenings except where exposed fastenings are required. Insulate exterior frame components with mineral fibre insulation. Provide appropriate anchorage to floor and wall construction..

.5 Provide jamb anchors for fixing at floor.

.6 Fabricate thermally broken frames for exterior doors using steel core, separating exterior portion of frame from interior portion with PVC thermal breaks.

2.4 Fabrication - Doors

.1 Doors General: Fabricate swing type doors, flush, with longitudinal edges seamless, continuously spot welded, filled, and sanded flush.

.2 Hollow Steel Construction: Form each face sheet for exterior and interior doors from sheet steel. Reinforce doors with vertical stiffeners, securely welded or laminated to each face sheet at 150 mm (6”) on centre maximum. Fill voids between stiffeners of exterior doors with fibreglass core.

.3 Fabricate doors with top and bottom steel channels full width of door and welded to both faces. Provide flush steel top edge on exterior doors.

3. EXECUTION

3.1 Installation - General

.1 Touch up with primer galvanized finish damaged during installation.

3.2 Installation - Frames

.1 Set frames plumb, square, level and at correct elevation.

.2 Provide suitable anchors to suit construction. Use one base anchor and two wall anchors per jamb side for frames up to 1500 mm (60") and one additional wall anchor per jamb side for each additional height of 750 mm (30") or fraction thereof.

.3 Secure anchorages and connections to adjacent construction.

.4 Brace frames rigidly in position while building-in. Install temporary horizontal wood spreader at third points of door opening to maintain frame width. Remove temporary spreaders after frames are built-in.

.5 Make allowances for deflection of structure to ensure structural loads are not transmitted to frames.

3.3 Installation - Doors

.1 Provide even margins between doors and jambs and doors and finished floor and thresholds as follows:

.1 Hinge side: 3 mm ($^1/_8$").

.2 Latchside and head: 3 mm ($^1/_8$").

.3 Finished floor for non-rated assemblies: 12 mm ($^1/_2$"), unless otherwise indicated.

.2 Adjust operable parts for correct function.

3.4 Cleaning

.1 Clean and make good all surfaces soiled or otherwise damaged in connection with Work. Upon completion of work and remove debris, equipment and excess material from Site.

END OF SECTION

ALUMINUM WINDOWS

1. GENERAL

1.1 System Description

.1 Performance Criteria: Windows shall meet following CAN/CSA-A440-M window classification ratings provided, however, thickness of extruded aluminum components shall not be less than 1.6 mm (0.062").

.1 Air Tightness: Fixed.

.2 Water Tightness: B3.

.3 Wind Load Resistance: C5.

1.2 Quality Assurance

.1 Installer: Trained and approved by the Manufacturer and having a minimum three (3) years experience in the installation of the work described in this Section and can show evidence of satisfactory completion of projects of similar size, scope and type. If requested, provide letter of certification from Manufacturer stating that the Installer is certified applicator of its products, and is familiar with proper procedures and installation requirements required by the Manufacturer.

.2 Pre-Installation Meeting: Ten (10) business days prior to commencing work of this Section, arrange for Manufacturer's Representative to visit the Site and review preparatory and installation procedures to be followed, conditions under which the work will be done, and inspect the surfaces to receive the work of this Section. Advise the Contract Administrator of the date and time of the meeting.

.3 Manufacturer’s Site Inspection: Have the Manufacturer’s Representative inspect the work at suitable intervals during application and at conclusion of the work of this Section, to ensure the work is correctly installed. When requested, submit Manufacturer’s inspection reports and verification that the work of this Section is correctly installed.

1.3 Submittals

.1 Shop Drawings: Include plans, elevations, sections, details, hardware, attachments to other work, and the following:

.1 Joinery details

.2 Expansion provisions

.3 Flashing and drainage details

.4 Thermal-break details

.5 Glazing details

.2 Maintenance Data and Operating Instructions: On completion of work, supply three (3) copies of maintenance and glazing instructions in accordance with the requirements in Section 01730 – Operation and Maintenance Manuals.

1.4 Delivery, Storage, and Handling

.1 Store in a dry, protected area On-Site, in original undamaged containers with Manufacturer's labels and seals intact.

.2 Store glazing units in dry and cool locations. Maintain air circulation between glazing units.

.3 Factory apply strippable coating or protective wrappings on exposed surfaces of aluminium. Do not remove protection until completion of building.

2. PRODUCTS

2.1 Materials

.1 Window Type: Fixed windows, thermally brokened, 5500 ISOWEB by Kawneer or 900E by Alumicor.

.2 Aluminium Association Alloy AA6063-T5 for extruded shapes, commercial quality AA1100-H14 aluminum sheet for formed shapes.

.3 Flashing: Aluminium, finished to match window framing, minimum 24 gauge.

.4 Bolts, Screws, Anchors and Fasteners: Stainless steel or aluminium for aluminium connections; cadmium plated steel may be used at interior side of air/vapour barriers; galvanized steel elsewhere.

.5 Slip washers: Teflon coated steel or aluminium washers.

.6 Loose Insulation: Glass fibre or mineral wool, CSA A101-M, Type I, Loose, light density insulation.

.7 Isolation Coating: Acid and alkali resistant.

2.2 Glass and Glazing

.1 All glazing materials, products, primers and cleaning solvents: Mutually compatible.

.2 Tinted Glass: Heat absorbing glass, Solargray by PPG.

.3 Low Emissivity Coating: Solarban 60 by PPG.

.4 Insulating Glass Units: CAN2-12.8, double glazed, composed of outer lite of minimum 6 mm thick tinted glass and inner lite of clear glass with low emissivity coating on No. 3 surface, separated by a 13 mm wide dehydrated air space, double sealed and atmospheric

pressure equalized to prevent bowing of the glass lites in the vertical position. Edges of glass shall be straight cut, free of nicks and other imperfections conducive to breakage.

.5 Set spacer core straight and even into glass units with a maximum variation in line of spacer core of plus or minus 2 mm and the primary seal not extend past the inside edge of spacer core by more than 1.6 mm. Weld or vulcanize spacer core corners and joints.

.6 Glass lites shall be float, tempered, laminated or heat strengthened and in thicknesses in accordance with requirements of glass manufacturer as substantiated by the glass Manufacturer's stress analysis for each location required, unless otherwise indicated.

.7 Shims: pressure sensitive resilient extruded synthetic rubber and as recommended by the insulating glass unit manufacturer.

.8 Spacers and Setting Blocks: 50 and 90 Durometer A hardness plus/minus 5 respectively, neoprene rubber, resistant to sunlight, weathering, oxidation and permanent deformation under load.

.9 Glazing Tape: Extruded, ribbon shaped, non-drying, non-skinning, non-oxidizing polyisobutylene tape with continuous synthetic rubber spacer rod, sufficiently wide and thick as to completely cover the bite area of the glazing unit when the unit is pushed into place, Polyshim tape by Tremco, Space-R-Tape by the PRC Chemical Corporation of Canada Limited, PTI 606 by PTI Sealants Ltd., or other acceptable equivalents.

.10 Glazing Gaskets: Neoprene or EPDM of sufficient thickness to be 25% compressed when installed. Gaskets shall have a 2000 psi tensile strength, Durometer A hardness of 50, plus/minus 5, resistance to permanent set 30% maximum, minimum elongation at break of 300% and resistance to ozone showing no cracks.

2.3 Sealants

.1 Joint Primer, Surface Conditioners and Cleaning Agents: As recommended by respective glazing and sealant compound Manufacturer.

.2 Joint Backing Material**:** Polyethylene foam rope, closed cell type, out-sized minimum 50% larger than joint width and compatible with joint sealant.

.3 Sealant: Non-bleeding, non-migrating, non-sagging, capable of supporting their own weight, standard colour.

.1 Sealant Between Aluminium Framing and Adjacent Structures: CAN/CGSB-19.24-M, Type 2, Class B, multi-component, urethane based.

.2 Sealant for Heel Beads: CAN/CGSB-19.13-M, Class MCG-2-25-A-N, one component, silicone base.

2.4 Fabrication – Window Frames

.1 Form work true to detail, free from defects impairing appearance, strength, and durability.

.2 Fabricate aluminium windows with an integral, concealed, low-conductance thermal barrier; located between exterior materials and window members exposed on interior side; in a manner that eliminates direct metal-to-metal contact.

.3 Apply sealant to joints within window units and components, including junction of frames to provide air/vapour and watertight joints. Do such sealant application in a concealed manner.

.4 Provide punched louvres or holes through exterior glazing flange for venting and drainage.

.5 Design mullions and framing members to accommodate glazing units.

.6 Design, fabricate and install brackets and anchorage devices attached to warm side of thermal break. Make allowance for unevenness and dimensional difference in structure, expansion and contraction of framing members without creating undesirable stresses in components to adequately sustain windows, movements in structure, and superimposed wind and rain loads.

.7 Form continuous sills, stools and flashings with intermediate clips, anchor devices and reinforcement in shop and as far as practical assemble units in shop. Supply filler and closure pieces as required. Fill corners and other open areas within construction with loose insulation.

.8 Ensure corners of formed work are mitred and closely fitted. Apply back-up sealants designed for this purpose, on inside of joints in aluminum work by this trade. Provide drainage towards exterior at bottom of glazing rebates.

.9 Deburr and make smooth sharp milled edges and corners of sash frames.

.10 Construct and erect windows free of exposed fasteners. If unavoidable, ensure fasteners are tamper proof.

.11 Apply two (2) shop coats of rust inhibiting primer to steel components. Take other necessary measures to prevent future deterioration due to corrosion and electrolysis during fabrication.

2.5 Aluminum Finishes

.1 Prefinish exposed to view aluminium surfaces. Ensure aluminium finish is free from blemishes or scratches and uniform in colour and sheen. Pretreat aluminium and apply primer and finish coats in accordance with Manufacturer's instructions.

.1 High performance fluoropolymer metallic finish: AA-C12C40R1x, chemical finish: cleaned with inhibited chemicals; chemical finish: conversion coatings; organic coating: Manufacturer's standard three coat, thermocured system consisting of specially

formulated inhibitive primer, fluoropolymer colour coat, and clear fluoropolymer topcoat, with both colour coat and clear topcoat containing not less than 70% polyvinylidene fluoride resin by weight. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with AAMA 2605 and with coating and resin Manufacturers' written instructions.

3. EXECUTION

3.1 Installation - General

.1 Apply isolation coating of approximately 0.76 mm (30 mil) dry film thickness, or other suitable permanent separator on concealed contact surfaces of dissimilar materials, before assembly or installation where there is possibility of corrosive or electrolytic action (e.g. aluminum to concrete, masonry, mortar, plaster, or steel).

.2 Install windows in accordance with CAN/CSA-A440-M and requirements specified herein.

.3 Set window framing in its correct location, level, square and plumb and at proper elevations, with nominal face of framing aligned in a single vertical plane. Fasten and anchor framing in place. Install in accordance with Manufacturer's instructions and reviewed shop drawings.

.4 Anchor component parts securely in place as indicated, by bolting or other permanent mechanical attachment system, which will comply with performance requirements and permit movement as intended or necessary.

.5 Clean and restore primer and bituminous paint to surfaces disturbed by field welding or other operations.

.6 Leave final installation water, air and weather tight.

3.2 Installation - Glazing

.1 Free rabbets, stops and glass edges of dust, dirt, moisture, oil and other foreign matter detrimental to glazing material adhesion. Ensure drainage holes are not blocked.

.2 Place two (2) setting blocks under each unit at quarter points. Place spacers on all edges of glass, located directly opposite each other when on both sides of the glass, located at maximum 600 mm (24") centres and maximum 300 mm (12") from corners and uniformly spaced.

.3 Install glazing tapes and gaskets to ensure complete contact on surface of glass and stops. Make joints only at corners of sash or frame. Fit accurately with tight joints, free from tension, gaps, cracks and embedded foreign matter.

.4 Set glass properly cantered with uniform bite and face and edge clearance, free from twist, warp or other distortion likely to develop stress.

.5 Ensure water and air tight seal for glass between glazed element and frame is flush with sight line.

.6 Perform glazing only when the temperature is above 4°C.

3.3 Installation - Sealant

.1 Prepare and seal joints to provide weathertight seal.

.2 Apply sealant to joints between windows, sills, and other components in this Section and adjacent construction both inside and outside to provide weather tight seal on exterior and air/vapour seal on interior. Provide toe bead and/or heal bead of sealant around perimeter or sealed unit to prevent air leakage.

.3 Apply joint backing to achieve correct joint depth and shape in accordance with manufacturer's instructions.

.4 Mix, apply and cure sealant in strict accordance with manufacturer's instructions.

.5 Apply sealant in continuous full beads, using gun with proper size nozzle and sufficient pressure to fill voids and joints solid.

.6 Form surfaces smooth, free from ridges, wrinkles, sags, air pockets, embedded impurities.

.7 Tool exposed surfaces to slightly concave shape.

.8 Remove excess compound promptly as work progresses and upon completion.

.9 Glazing:

.1 Provide heel bead at bottom of interior edge of sealed units and up lower 75 mm (3") of each vertical to provide a vented glazing cavity.

.2 Neatly tool glazing compound at an angle sloping away from glass. Remove excess glazing compound from stops and glass.

3.4 Extended Warranties

.1 Submit a ten (10) year warranty against defects in the insulating glass units and warrant them to be free from material obstruction of vision as a result of dust or film formation on the internal glass surfaces by any cause, under design conditions, other than extrinsic glass breakage, but including breakage due to thermal shock and temperature differential due to inherent glass faults.

.1 The glass coatings will not discolour, oxidize, delaminate, or have scratches and pinholes and shall be uniform in thickness and uniform in colour throughout each glass unit and from glass unit to glass unit.

.2 Insulating glass units will be free from condensation, fogging material obstruction of vision as a result of dust or film formation on the internal glass surfaces by any cause under normal conditions.

.3 The insulating glass units will not change their mechanical design properties and shall not in any way deteriorate, degrade, delaminate or change their visual appearance.

3.5 Adjust and Clean

.1 Maintain window in a clean condition throughout construction period, without deterioration or damage at time of acceptance. Select methods of cleaning which will promote achievement of uniform appearance and stabilized colours and textures for materials that weather or age with exposure. Do not use abrasives.

.2 Adjust operating devices and leave in perfect working order.

.3 Immediately prior to cleaning of glass and before building is handed over to the City, make good damage and disfigurement. Remove protective covering and coating from aluminum surfaces, inside and out, and clean surfaces, remove labels, stripes and protective devices and polish glass surfaces, immediately prior to final acceptance.

.4 Immediately before Total Performance, clean windows thoroughly, inside and out. Demonstrate proper cleaning methods to the City during final cleaning.

END OF SECTION

COATING SYSTEMS FOR STEEL PIPES

1. GENERAL

1.1 References

.1 The following is a list of standards which may be referenced in this Section:

.1 NSF International (NSF): 61, Drinking Water System Components-Health Effects.

.2 SSPC:

.1 SP 1, Surface Preparation Specification No. 1, Solvent Cleaning.

.2 SP 2, Hand Tool Cleaning.

.3 SP 3, Power Tool Cleaning.

.4 SP 5, White Metal Blast Cleaning.

.5 SP 6, Commercial Blast Cleaning.

.6 SP 7, Brush-Off Blast Cleaning.

.7 SP 8, Pickling.

.8 SP 10, Near-White Blast Cleaning.

.9 SP 11, Power Tool Cleaning to Bare Metal.

.10 SP 12, High Pressure Water Jetting.

.3 AWWA:

.1 C210, Liquid-Epoxy Coating Systems for the Interior and Exterior of Steel Water Pipelines.

.4 NACE:

.1 RP0188-99 Discontinuity (Holiday) Testing of New Protective Coatings on Conductive Substrates

1.2 Definitions

.1 Terms used in this Section:

.1 Coverage: Total minimum dry film thickness in mil, or m^2/L.

.2 MDFT: Minimum Dry Film Thickness, mm.

.3 MDFTPC: Minimum Dry Film Thickness per Coat, mm.

.4 Mil: Thousandth of an inch.

.5 PSDS: Paint System Data Sheet.

.6 SP: Surface preparation.

1.3 Submittals

.1 Action Submittals:

.1 Data Sheets:

.1 For each paint system used, furnish a painting system data sheet, and paint colours available (where applicable) for each product used in the paint system, except for products applied by equipment manufacturers.

.2 Submit required information on a system-by-system basis.

.3 Provide copies of paint system submittals to coating applicator.

.4 Indiscriminate submittal of Manufacturer's literature only is not acceptable.

.2 Detailed chemical and gradation analysis for each proposed abrasive material.

.3 Samples: Proposed Abrasive Materials: 2 kg minimum Sample for each proposed.

.2 Informational Submittals:

.1 Anticipated tank coating sequence.

.2 Coating Manufacturer's letter or certificate stating that the proposed product, material, or service complies with that specified. Attach supporting reference data, affidavits, and certifications as appropriate.

.3 Copy of applicable NSF listings.

.4 Applicator's Qualification: List of references substantiating experience.

.5 Manufacturer's written instructions for applying each type of coating.

.6 Field Testing: Inspection and test reports.

.7 Certificate of Satisfactory Installation, Form 102.

1.4 Quality Assurance

.1 Applicator Qualifications: Minimum five (5) years' experience in application of specified products.

.2 Regulatory Requirements:

.1 Meet federal, provincial, and local requirements limiting the emission of volatile organic compounds.

.2 Perform surface preparation and painting in accordance with recommendations of the following:

.1 Paint Manufacturer's instructions.

.2 SSPC-PA Guide No. 3, Guide to Safety in Paint Applications.

.3 Federal, provincial, and local agencies having jurisdiction.

.3 Mockup:

.1 Before proceeding with Work under this Section, finish one complete space or item of each colour scheme required showing selected colours, finish texture, materials, quality of Work, and special details.

.2 After approval, sample spaces or items shall serve as a standard for similar work throughout the Work.

1.5 Delivery, Storage, and Handling

.1 Deliver materials to Site in unopened containers labeled with designated name, date of manufacture, colour, and Manufacturer.

.2 Store paints in a protected area that is heated or cooled as required to maintain temperatures within the range recommended by paint Manufacturer.

.3 Shipping:

.1 Protect precoated items from damage. Batten coated items to prevent abrasion.

.2 Use nonmetallic or padded slings and straps in handling.

1.6 Environmental Requirements

.1 Do not apply paint in temperatures outside of Manufacturer's recommended maximum or minimum allowable, or in dust, smoke-laden atmosphere, damp or humid weather.

.2 Do not perform abrasive blast cleaning whenever relative humidity exceeds 85%, or whenever surface temperature is less than 3°C above dewpoint of ambient air.

2. PRODUCTS

2.1 Manufacturers

.1 Ameron Protective Coatings, Brea, CA.

.2 Benjamin Moore Paints, New York, NY.

.3 Carboline Coatings Company, St. Louis, MO.

.4 ICI Devoe, Louisville, KY.

.5 DuPont Chemical Co., Wilmington, DE.

.6 Hempel/Reliance Paints, Houston, TX.

.7 Keeler and Long, Inc., Watertown, CT.

.8 Master Builders, Inc., Cleveland, OH.

.9 Plas-Chem Coatings, St. Louis, MO.

.10 International Protective Coatings, Houston, TX.

.11 Sherwin-Williams, Cleveland, OH.

.12 Tnemec Coatings, Kansas City, MO.

.13 Plasite Protective Coatings, Green Bay, WI.

.14 Cloverdale Paint, Surrey, BC.

.15 Enviroline, Pompano Beach, FL.

2.2 Materials

.1 Quality: Manufacturer’s highest quality products and suitable for intended use.

.2 Abrasives: As recommended by paint Manufacturer to produce surface profile recommended for specific paint system.

.3 Materials Including Primer and Finish Coats: Produced by same paint Manufacturer.

.4 Thinners, Cleaners, Driers, and Other Additives: As recommended by paint Manufacturer of the particular coating.

.5 Polyamide Epoxy: Polyamide epoxy coatings approved for potable water contact conforming to NSF 61.

.6 Polyurethane Enamel: Two-component, aliphatic or acrylic based polyurethane; high gloss finish.

.7 Wash Primer: Vinyl butyral acid.

.8 Rust Inhibitive Primer: Single package steel primer with anticorrosive pigment loading.

.9 Alkyd Enamel: Gloss finish, medium oil length.

2.3 Colours

.1 Formulate with colorants free of lead and lead compounds.

.2 Furnish as selected by Contract Administrator.

.3 Proprietary identification of colours is for identification only; selected manufacturer may supply matches.

2.4 Mixing

.1 Multiple-Component Coatings:

.1 Prepare using all the contents of the container for each component as packaged by paint Manufacturer.

.2 No partial batches will be permitted.

.3 Do not use multiple-component coatings that have been mixed beyond their pot life.

.4 Furnish small quantity kits for touch-up painting and for painting other small areas.

.5 Mix only components specified and furnished by paint Manufacturer.

.6 Do not intermix additional components for reasons of colour or otherwise, even within the same generic type of coating.

.2 Keep paint material containers sealed when not in use.

3. EXECUTION

3.1 General

.1 Coatings and linings on steel piping shall be applied in strict accordance with AWWA C210.

3.2 Preparation

.1 Notify the Contract Administrator at least seven (7) days prior to start of shop blast cleaning to allow for inspection of the Work during surface preparation and shop application of paints. Work shall be subject to the Contract Administrator approval before shipment to Site.

.2 Protect all surfaces adjacent to, or downwind of Work area from overspray. Contractor shall be responsible for any damage resulting from overspray.

3.3 Preparation of Surfaces

.1 Metal Surfaces:

.1 Meet requirements of the following SSPC Specifications as referenced in specific coating systems:

.1 Solvent Cleaning: SP 1.

.2 Hand Tool Cleaning: SP 2.

.3 Power Tool Cleaning: SP 3.

.4 White Metal Blast Cleaning: SP 5.

.5 Commercial Blast Cleaning: SP6

.6 Brush-Off Blast Cleaning: SP 7.

.7 Near-White Blast Cleaning: SP 10.

.8 Power Tool Cleaning to Bare Metal: SP 11.

.9 High Pressure Water Jetting: SP 12.

.2 Wherever the words “solvent cleaning”, “hand tool cleaning”, “wire brushing”, or “blast cleaning”, or similar words of equal intent are used in these Specifications or in paint Manufacturer’s specifications, they shall be understood to refer to the applicable SSPC Specifications listed above.

.3 Hand tool clean areas that cannot be cleaned by power tool cleaning.

.4 Preblast Cleaning Requirements:

.1 Remove oil, grease, welding fluxes, and other surface contaminants prior to blast cleaning.

.2 Cleaning Methods: Steam, open flame, hot water, or cold water with appropriate detergent additives followed with clean water rinsing.

.3 Clean small isolated areas as above or solvent clean with suitable solvents and clean cloths.

.4 Round or chamfer sharp edges and grind smooth burrs, jagged edges, and surface defects.

.5 Welds and Adjacent Areas:

.1 Prepare such that there is:

.1 No undercutting or reverse ridges on weld bead.

.2 No weld spatter on or adjacent to weld or other area to be painted.

.3 No sharp peaks or ridges along weld bead.

.2 Grind embedded pieces of electrode or wire flush with adjacent surface of weld bead.

.6 Blast Cleaning Requirements:

.1 Type of Equipment and Speed of Travel: Design to obtain specified degree of cleanliness. Minimum surface preparation is as specified herein and takes precedence over coating manufacturer's recommendations.

.2 Select type and size of abrasive to produce a surface profile that meets coating Manufacturer's recommendations for particular primer to be used.

.3 Use only dry blast cleaning methods.

.4 Do not reuse abrasive, except for designed recyclable systems.

.5 Meet applicable federal, provincial, and local air pollution and environmental control regulations for blast cleaning and disposition of spent aggregate and debris.

.7 Post-Blast Cleaning and Other Cleaning Requirements:

.1 Clean surfaces of dust and residual particles from cleaning operations by dry (no oil or water vapor) air blast cleaning or other method prior to painting.

Vacuum clean enclosed areas and other areas where dust settling is a problem and wipe with a tack cloth.

.2 Paint surfaces the same day they are blast cleaned. Reblast surfaces that have started to rust before they are coated.

3.4 Application

.1 General:

.1 The intention of these Specifications is for new interior and exterior metal and submerged metal surfaces to be painted, whether specifically mentioned or not, except as modified herein.

.2 Extent of Coating (Immersion): Coatings shall be applied to all internal vessel and pipe surfaces, nozzle bores, flange gasket sealing surfaces, carbon steel internals, and stainless steel internals, unless otherwise specified.

.3 For coatings subject to immersion, obtain full cure for completed system. Consult coatings Manufacturer's written instructions for these requirements. Do not immerse coating until completion of curing cycle.

.4 Apply coatings in accordance with paint manufacturer's Recommendations. Allow sufficient time between coats to assure thorough drying of previously applied paint.

.5 Paint units to be bolted together and to structures prior to assembly or installation.

.6 Where more than one (1) coat of a material is applied within a given system, alternate colour to provide a visual reference that the required number of coats have been applied.

.2 Shop Primed Surfaces:

.1 Schedule inspection with the Contract Administrator before shop primed items are delivered to Site.

.2 Hand or power sand areas of chipped, peeled, or abraded coating, feathering the edges. Follow with a spot primer using specified primer.

.3 For two-package or converted coatings, consult coatings Manufacturer for specific procedures as relates to Manufacturer's products.

.4 Prior to application of finish coats, clean shop primed surfaces free of dirt, oil, and grease and apply mist coat of specified primer, 1 mil dry film thickness.

.5 After welding, prepare and prime holdback areas as required for specified paint system. Apply primer in accordance with Manufacturer's instructions.

.3 Stripe Coating:

.1 Stripe coat all field welds, edges, angles, fasteners, and other irregular surfaces located inside tanks.

.2 Stripe coat shall consist of one coat, brush applied, to the coating thickness specified.

.3 Apply stripe coat between intermediate and final coats.

.4 Stripe coat colour shall contrast intermediate coat to allow visual verification of application.

.4 Film Thickness:

.1 Number of Coats: Minimum required without regard to coating thickness. Additional coats may be required to obtain minimum required paint thickness, depending on method of application, differences in Manufacturers' products, and atmospheric conditions.

.2 Maximum film build per coat shall not exceed coating Manufacturer's recommendations.

.3 Film Thickness Measurements and Electrical Inspection of Coated Surfaces:

.1 Perform with properly calibrated instruments.

.2 Recoat and repair as necessary for compliance with the Specifications.

.3 All coats are subject to inspection by the Contract Administrator and coating Manufacturer's representative.

.4 Give particular attention to edges, angles, flanges, and other similar areas, where insufficient film thicknesses are likely to be present, and ensure proper millage in these areas.

.5 Thickness Testing:

.1 After repaired and recoated areas have dried sufficiently, final tests will be conducted by the Contract Administrator.

.2 Measure coating thickness specified in mils with a magnetic type dry film thickness gauge.

.3 Test finish coat for holidays and discontinuities with an electrical holiday detector, low voltage, wet sponge type.

.4 Check each coat for correct millage. Do not make measurement before a minimum of eight (8) hours after application of coating.

.5 Damaged Coatings, Pinholes, and Holidays:

.1 Feather edges and repair in accordance with recommendations of paint Manufacturer.

.2 Hand or power sand visible areas of chipped, peeled, or abraded paint, and feather the edges. Follow with primer and finish coat in accordance with the Specifications. Depending on extent of repair and appearance, a finish sanding and topcoat may be required.

.3 Apply finish coats, including touch-up and damage-repair coats in a manner that will present a uniform texture and colour-matched appearance.

.6 Unsatisfactory Application:

.1 If item has an improper finish colour, or insufficient film thickness, clean surface and topcoat with specified paint material to obtain specified colour and coverage. Obtain specific surface preparation information from coating manufacturer.

.2 Evidence of runs, bridges, shiners, laps, or other imperfections are causes for rejection.

.3 Repair defects in coating systems in accordance with written recommendations of coating manufacturer.

.4 Leave all staging up until the Contract Administrator has inspected surface or coating. Replace staging removed prior to approval by the Contract Administrator.

3.5 Field Quality Control

.1 Testing Gauges:

.1 Provide a magnetic type dry film thickness gauge to test coating thickness specified in millimetres, as Manufactured by Nordson Corp., Anaheim, CA, Mikrotest.

.2 Provide an electrical holiday detector, low voltage, wet sponge type to test finish coat, except zinc primer, high-build elastomeric coatings, and galvanizing, for holidays and discontinuities as manufactured by Tinker and Rasor, San Gabriel, CA, Model M-1.

.2 Test all coated surfaces with a holiday detector in accordance with NACE RP0188. Coated surfaces shall be free of holidays.

3.6 Manufacturer's Services

.1 The coating Manufacturer's Representative shall be present at shop or Site as follows:

.1 On the first day of application of any coating.

.2 A minimum of two (2) additional inspection visits, each for a minimum of four (4) hours, in order to provide Form 102 Certificate of Satisfactory Installation.

.3 As required to resolve field problems attributable to, or associated with the Manufacturers' product.

3.7 Cleanup

.1 Place cloths and waste that might constitute a fire hazard in closed metal containers or destroy at the end of each day.

.2 Upon completion of the Work, remove staging, scaffolding, and containers from the Site or destroy in a legal manner.

.3 Completely remove paint spots, oil, or stains upon adjacent surfaces and floors and leave entire job clean.

3.8 Protective Coatings Systems

.1 System No. 1 Submerged or Embedded Metal-Potable Water:

Surface Prep.	Paint Material	Min. Coats, Cover
Abrasive Blast (SP10)	Potable Grade, Polyamide Epoxy Coating	3 coats, 0.08mm MDFTPC (3 mils MDFTPC)

.1 Application Schedule:

.1 Use this system on all metal surfaces inside piping, including, but not limited to, steel plates and structural steel; interior and exterior surfaces of the overflow piping; ladders; landings; couplings; and vents.

.2 Use this system on the exposed surfaces of direct buried and concrete encased steel pipe.

.2 System No. 5 Exposed Metal:

Surface Prep.	Paint Material	Min. Coats, Cover
Abrasive Blast, or Centrifugal Wheel Blast (SP 10)	Polyamide, Anticorrosive Epoxy Primer (Beige Colour)	1 coat, 0.064 mm MDFT (2.5 mils MDFT)
	Polyurethane Enamel	1 coat, 0.08 mm MDFT (3 mils MDFT)

.1 Application Schedule: Use this system on exposed exterior metal surfaces of piping.

END OF SECTION

PAINTING

1. GENERAL

1.1 Quality Assurance

.1 Employ a Subcontractor with a minimum of two (2) years experience as an independent contractor specializing in painting.

1.2 Delivery, Storage, and Handling

.1 Provide a room or rooms for storage of paint materials and equipment. Keep room clean, under lock and key, and surrounding surfaces protected against damage. Provide a carbon dioxide fire extinguisher in each storage room.

.2 Keep oily rags, waste and other similar combustible materials in closed metal containers and remove at end of each day. Take precautions to avoid spontaneous combustion.

.3 Provide adequate cover for all finished work close to surfaces to be painted. Covers shall be placed before painting commences and remain until completed.

.4 Post "wet paint" signs while work is in process or drying.

.5 Post "no smoking" signs where volatile materials are being used.

2. PRODUCTS

2.1 Materials

.1 Paint and finishing materials: Highest grade, first line quality of the Manufacturer.

.2 Thinners, cleaners, etc.: Type and brand recommended by the paint manufacturer, bearing identifying labels.

.3 Gloss terms: Having the following values when tested in accordance with ASTM D523 "Test for Specular Gloss", 60° gloss meter method:

.1 Flat: 5 to 20.

.2 Eggshell: 20 to 40.

.3 Semi-gloss: 40 to 60.

.4 Gloss: 60+.

3. EXECUTION

3.1 Preparation - General

.1 Furnish sufficient drop cloths, shields and protective equipment to prevent spray or dropping from fouling surfaces not being painted.

.2 Place cotton waste, cloths and material which may constitute a fire hazard in metal containers and remove daily from site.

.3 Remove surface hardware, fittings and fastenings, prior to painting operations. Store and replace in undamaged condition on completion of work in each area.

.4 Mask off and protect finished surfaces and materials in a manner acceptable to the Contract Administrator.

3.2 Preparation - Metal Surfaces

.1 Primed steel: Before touch-up of prime paint, smooth out surface irregularities; clean weld joints, bolts, nuts, and damaged areas with phosphoric acid solution; and wash with solvent.

.2 Galvanized steel: Prepare galvanized surfaces using abrasive blast cleaning with sand. Wash thoroughly with mineral spirits, and wipe dry with completely clean cloths. Phosphatize surfaces, or apply one coat of etch type primer unless otherwise specified.

3.3 Application

.1 Do Work by skilled tradesman, to Manufacturer's directions. Apply paint only when dust-free conditions prevail. Results shall be even, uniform in sheen, colour and texture; free from brush or roller marks, or other defects.

.2 Apply paint by brush or roller. Spray painting may be permitted at the approval of the Contract Administrator before work commences.

.3 The Contract Administrator may at any time prohibit the use of spray painting for such reasons as carelessness, poor masking or protective measures, drifting paint fog, disturbance to other trades or failure to obtain a dense, even, opaque finish.

.4 Do not paint exterior surfaces during windy or rainy weather, or when temperature is below 10°C, or when surfaces are damp or exposed to hot sun.

.5 Permit paint to dry before applying succeeding coats.

.6 Tint various coats of multiple coat work to distinguish between coats.

.7 Use same brand of paint for primer, intermediate, and finish coats.

.8 Reduce materials only when indicated by paint manufacturer. Reduce only with approved thinner.

.9 Remove finishing hardware, fittings and trim prior to painting and replace after painting is finished. Alternatively, use masking tape and remove tape before paint is dry.

.10 Strain paint through fine mesh if hardened paint or foreign materials are present in the container.

3.4 Paint Finishes

.1 For primed ferrous metal surfaces apply: One coat lead primer and two coats exterior gloss alkyd enamel.

.2 For galvanized and zinc coated metal surfaces apply: One coat rust inhibitive primer and two coats exterior gloss alkyd enamel.

3.5 Cleaning

.1 Remove paint marks and spatterings, as work proceeds and on completion.

END OF SECTION

CLEANING AND DISINFECTION OF STRUCTURES

1. GENERAL

1.1 Work Included

.1 Cleaning of Water Retaining Structures

.1 The Contractor shall include cost for removal of construction materials, pressure washing, power, disposal of waste debris, water and any other systems required for successful cleaning of structures. Water will be made available to the Contractor for one cleaning at no cost.

.2 Disinfection of Water Retaining Structures

.1 The Contractor shall include the cost for water conveyance/fill system, chemicals, power, dechlorination, and disposal of water and any other system required for successful disinfection of structures. Water will be made available to the Contractor for one test at no cost. Related Codes include:

.1 AWWA C651 Disinfecting Water Mains

.2 AWWA C652 Disinfection of Water Storage Facilities

.3 AWWA C653 Disinfection of Water Treatment Plants

1.2 Coordination

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

1.3 Schedule of Items to be Cleaned and Disinfected

.1 The Contractor shall clean and disinfect all items which will be used for the conveyance or storage of potable water.

1.4 Entry into Existing Structures

.1 Where work is undertaken within existing structures or piping used for the storage or conveyance of potable water, they shall be disinfected prior to being put back into service.

2. MATERIALS

2.1 Water

.1 Water for disinfection will be provided by the City (only for one test). Contractor shall be responsible for all systems required for the conveyance of the available water and fill system from an acceptable water extraction point. The water shall be free from all suspended and deleterious material. The water can be obtained from the existing water supply system after

consultation with the Contract Administrator. Contractor shall provide a plan of water extraction from the existing system and aquire approval of the plan from the Contract Administrator.

2.2 Calcium Hypochlorite

.1 Calcium hypochlorite shall comply with AWWA B-300.

2.3 Sodium Hypochlorite

.1 Sodium hypochlorite shall comply with AWWA B-300.

3. EXECUTION

3.1 Applicable Standards

.1 Except as otherwise specified, the work shall be undertaken in accordance with the following codes:

.1 AWWA C651 Disinfecting Water Mains

.2 AWWA C652 Disinfection of Water Storage Facilities

.3 AWWA C653 Disinfection of Water Treatment Plants.

3.2 Cleaning

.1 All structures shall be thoroughly cleaned prior to final acceptance.

.2 All construction material not part of the permanent structure shall be removed.

.3 The surfaces of walls, floor and roof of structures shall be cleaned using a high pressure jet, sweeping, scrubbing or equally effective means.

3.3 Disinfection of Piping

.1 Meet the requirements of AWWA C651, unless otherwise specified.

.2 Disinfecting Mixture:

.1 A chlorine-water solution having a free chlorine residual of 40 mg/L to 50 mg/L.

.3 Prepare by injecting one of the following:

.1 Liquid chlorine gas-water mixture.

.2 Calcium or sodium hypochlorite and water mixture.

.3 Inject mixture into pipeline at a measured rate while freshwater is allowed to flow through the pipeline at a measured rate so the combined mixture of freshwater and chlorine solution is of the specified strength.

.4 Apply liquid chlorine -water mixture by means of a chlorinating device.

.5 Calcium Hypochlorite: if this procedure is used, first mix dry powder with water to make a thick paste; then thin to approximately a 1 percent solution (10,000 mg/L chlorine).

.6 Sodium Hypochlorite: if this procedure is used, dilute liquid with water to obtain a 1 percent solution.

.7 The following proportions of hypochlorite to water will be required:

Product	Quantity	Water
Calcium Hypochlorite [1] (65 – 70% C1)	0.5 kg	28.5 Litres
Sodium Hypochlorite [2] (5.25% C1)	3.8 Litres	16 Litres

1. Comparable to commercial products known as HTH, Perchloron, and Pittchlor.
2. Known as liquid laundry bleach, Clorox, and Purex.

.4 Point of Application:

.1 Inject chlorine mixture into piping to be treated at the beginning of the line through a suitable tap in the piping.

.2 Control clean water from the existing system or another source so it flows slowly into newly installed piping during chlorine application.

.3 Manipulate valves so the strong chlorine solution in the line being treated will not flow back into the line supplying the water. Use check valves if necessary.

.5 Retention Period:

.1 Retain treated water in pipeline for a minimum of 24 hours or long enough to destroy nonspore-forming bacteria.

.2 At the end of the retention period, the disinfecting mixture shall have a strength of at least 10 mg/L of chlorine.

.3 Operate valves, hydrants, and other appurtenances during disinfection to assure disinfecting mixture is dispersed into all parts of the pipeline including dead ends, new services, and similar areas that otherwise may not receive the disinfecting solution.

.4 Do not place concentrated quantities of commercial disinfectants in pipeline before filling with water.

.5 After chlorination, flush the water from the permanent source of supply until water through pipeline is equal chemically and bacteriologically to the permanent source of supply.

.6 Sample water and have bacteriological testing performed by an approved lab. Submit a report to the Contract Administrator.

3.4 Disinfection of Structures

.1 The structure shall be disinfected prior to final filling of the structure and commissioning.

.2 A solution of 200 mg/L available chlorine shall be applied directly to the surfaces of all parts of the structure including the underside of the roof. The solution shall be applied by suitable brushes or spray equipment, and shall thoroughly coat all surfaces. The disinfected surfaces shall remain in contact with the solution for at least 30 minutes before the structure is washed with water.

3.5 Disposal of Chlorinated Water

.1 After the disinfection process is complete, the heavily chlorinated water shall be drained and disposed of in a manner approved by the Contract Administrator.

.2 Heavily chlorinated water shall not be discharged without first obtaining the permission of regulatory authorities. Dispose of disinfecting water in an acceptable manner that will protect the public and receiving waters from harmful or toxic concentrations of chlorine.

.3 If other disposal methods are impractical, dechlorinate the chlorinous water using methods outlined in AWWA C653.

3.6 Filling of Piping and Structures

.1 Immediately following the disposal of the heavily chlorinated water, the piping and structure shall be filled with potable water in accordance with Contract Administrator's directions.

.2 Potable water used for filling of the structures shall be sampled to ensure that no bacteriological contamination exists in the fill water prior to placement in the pipes or structures.

3.7 Bacteriological Testing

.1 After the chlorination procedure is complete and the piping and structure has been filled with potable water, duplicate samples shall be taken at least 30 minutes apart and shall be tested for coliforms in accordance with the Standard Methods for the Examination of Water and Wastewater.

.2 For piping and pipelines a minimum of one sample shall be collected for every 500 m of line disinfected.

.3 Bacteriological testing is to be performed at an approved laboratory that is able to perform the tests. Transportation and testing of samples are at Contractor's expense.

.4 Contractor shall be responsible for all sampling, testing and laboratory analyses.

3.8 Disinfection

.1 If the initial disinfection fails to produce satisfactory bacteriological samples, the structure shall be reflushed and water resampled.

.2 If check samples show the presence of coliform organisms, then the main or structure shall be redisinfected until satisfactory results are obtained.

.3 All costs associated with the redisinfection and testing shall be borne by the Contractor.

3.9 Placing Into Service

.1 No piping, structure or tank that is required to be disinfected shall be placed into service until bacteriological samples indicate the absence of contamination.

3.10 Entry into Existing or Previously Disinfected Potable Watermains or Structures

.1 Where entry is required either into existing potable water storage structures or piping or into previously disinfected new structures, the Contractor shall assure that the following measures are taken:

.1 All personnel shall wear clean, dirt-free protective overalls and disinfected, clean rubber footwear. Such footwear shall be reserved solely for use within the affected areas and shall not be worn in undisinfected areas.

.2 All tools and equipment shall be clean, grease free and spray disinfected before use. Equipment which shows evidence of fuel, oil or grease leakage shall not be used.

.3 The immediate area surrounding the access point for the structures concerned shall be cleaned and spray disinfected prior to the start of work. All previously disinfected footwear, tools, or equipment removed outside this area of the affected structures shall be redisinfected on return.

.4 Disinfection of footwear, tools, equipment, and access areas shall be by spraying with a 200 mg/L concentrated chlorine/water solution.

.5 Workmen who show signs of illness shall not work within the affected structures or surrounding access area.

END OF SECTION

PROCESS PIPING

1. GENERAL

1.1 Scope

.1 This Section covers the supply, installation, testing, cleaning and placing into operation of all process piping systems including fittings.

1.2 References

.1 The following is a list of standards which may be referenced in this Section and any supplemental Data Sheets:

.1 ANSI:

.1 B16.5, Pipe Flanges and Flanged Fittings

.2 B16.21, Nonmetallic Flat Gaskets for Pipe Flanges

.3 B16.25, Butt Welding Ends

.4 B16.42, Ductile Iron Pipe Flanges and Flanged Fittings, Classes 150 and 300

.2 ASME:

.1 B31.3, Process Piping

.3 American Society for Nondestructive Testing (ASNT): SNT-TC-1A, Personnel Qualification and Certification in Nondestructive Testing.

.4 ASTM:

.1 A53/A53M, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless

.2 A105/A105M, Standard Specification for Carbon Steel Forgings for Piping Applications

.3 A181/A181M, Standard Specification for Carbon Steel Forgings, for General-Purpose Piping

.4 A307, Standard Specification for Carbon Steel Bolts and Studs, 60,000 psi Tensile Strength

.5 A320/A320M, Standard Specification for Alloy/Steel Bolting Materials for Low-Temperature Service

.6 A563, Standard Specification for Carbon and Alloy Steel Nuts

.7 D1330, Standard Specification for Rubber Sheet Gaskets

.5 AWWA:

.1 C110/A21.10, Ductile-Iron and Gray-Iron Fittings, 3 Inches through 48 Inches for Water and Other Liquids

.2 C111/A21.11, Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings

.3 C153/A21.53, Ductile-Iron Compact Fittings 3 Inches through 24 Inches and 54 Inches through 64 Inches, for Water Service

.4 C200, Steel Water Pipe - 6 Inches and Larger

.5 C207, Steel Pipe Flanges for Waterworks Service, Sizes 4 Inches through 144 Inches

.6 C208, Dimensions for Fabricated Steel Water Pipe Fittings

.7 C210, Liquid-Epoxy Coating System for the Interior and Exterior of Steel Water Pipelines.

.8 C213, Fusion Bonded Epoxy Coating for the Interior and Exterior of Steel Water Pipelines

.9 C606, Grooved and Shouldered Type Joints

.10 M11, Steel Pipe - A Guide for Design and Installation

.6 AWS:

.1 A5.8, Specification for Filler Metals for Brazing and Braze Welding

.2 QC 1, Standard for AWS Certification of Welding Inspectors

.7 NSF:

.1 60, Drinking Water Treatment Chemicals - Health Effects.

.2 61, Drinking Water System Components - Health Effects.

1.3 Design Requirements

.1 Where pipe diameter, thickness, pressure class, pressure rating, or thrust restraint is not shown or specified, design piping system in accordance with the following:

.1 Process Piping: ASME B31.3

.2 Buried Piping: H20-S16 traffic load with 1.5 impact factor, AASHTO Standard Specifications for Highway Bridges, as applicable

.3 Provincial Regulations

1.4 Submittals

.1 General:

.1 Provide process piping submittals separated in process areas as per drawing key plan:

.1 Y: Yard piping chambers area

.2 Identify process area in the title of all submittal transmittals.

.2 Shop Drawings:

.1 Shop Fabricated Piping:

.1 For epoxy coated steel piping, all sizes, provide detailed pipe fabrication or spool drawings showing fittings and bends, dimensions, field weld locations, coatings, hydrotest information and other pertinent information.

.2 For embedded piping 100 mm and larger, provide layout drawings showing location of each pipe section and each special length; number or otherwise designate laying sequence on each piece.

.2 Hydraulic Thrust Restraint for Restrained Joints: details including materials, sizes, assembly ratings, and pipe attachment methods.

.3 Dissimilar Buried Pipe Joints: joint types and assembly Drawings.

.3 Quality Control Submittals:

.1 Laboratory Testing Equipment: certified calibrations, Manufacturer's product data, and test procedures

.2 Certified welding inspection and test results

.3 Qualifications:

.1 Weld Inspection and Testing Agency: Certification and qualifications

.2 Welding Inspector: certification and qualifications

.3 Welders:

.1 List of qualified welders and welding operators

.2 Current test records for qualified welder(s) and weld type(s) for factory and field welding

.4 Weld Procedures: records in accordance with ASME Boiler and Pressure Vessel Code, Section IX for weld type(s) and base metal(s)

.5 Nondestructive inspection and testing procedures

.6 Manufacturer's Certification of Compliance:

.1 Pipe and fittings.

.2 Welding electrodes and filler materials.

.3 Factory applied resins and coatings.

.7 Certified weld inspection and test reports

.8 Test logs

.9 Pipe coating applicator certification

1.5 Qualifications

.1 Independent Inspection and Testing Agency:

.1 Ten (10) years' experience in field of welding and welded pipe and fittings' testing required for this Work.

.2 Calibrated instruments and equipment, and documented standard procedures for performing specified testing.

.3 Certified in accordance with ASNT SNT-TC-1A for testing procedures required for this Work.

.4 Testing Personnel: qualified for non-destructive test methods to be performed.

.5 Inspection Services: qualified welding inspector.

.2 Welding Inspector: AWS certified, AWS QC 1 qualified, with prior inspection experience of welds specified.

.3 Welder and Welding Operator Qualifications:

.1 Qualified by accepted inspection and testing agency before starting Work in accordance with Section IX, Article III of the ASME Boiler and Pressure Vessel Code.

.2 Qualified to perform groove welds in Positions 2G and 5G for each welding process and pipe material specified.

.3 Qualification tests may be waived by the Contract Administrator based on evidence of prior qualification.

1.6 Quality Control

.1 Quality Control: Contractor shall provide services of independent inspection and testing agency for welding operations as approved by Contract Administrator.

.2 Welding materials, fabrication standards and labour qualifications shall conform to ANSI/ASME B31.1, ANSI/ASME B31.3, ANSI B16.25, ASME Boiler and Pressure Vessel Code, Section 9, CSA W59 and the Provincial Board of Labour Regulations.

.3 Use welders fully qualified and licensed by provincial authorities in accordance with CSA W59.

1.7 Delivery, Storage, and Handling

.1 General:

.1 Flanges: securely attach metal, hardboard, or wood protectors over entire gasket surface.

.2 Threaded or Socket Welding Ends: fit with metal, wood, or plastic plugs or caps.

.3 Linings and Coatings: prevent excessive drying.

.4 Cold Weather Storage: locate Products to prevent coating from freezing to ground.

.5 Handling: use heavy canvas or nylon slings to lift pipe and fittings.

2. PRODUCTS

2.1 Piping

.1 Piping material shall be epoxy lined and coated steel as specified on Piping Data Sheets located at the end of this Section as Supplement.

.2 Diameters Shown:

.1 Standardized Products: nominal size.

.2 Fabricated Steel Piping: outside diameter, ASME B36.10M.

2.2 Joints

.1 Grooved End System:

.1 Rigid, except where joints are used to correct misalignment, to provide flexibility, or where shown, furnish flexible type.

.2 Flanges: when required, furnish with grooved type flange adapters of same Manufacturer as grooved end couplings.

.2 Flanged Joints:

.1 Flat-faced carbon steel or alloy flanges when mating with flat-faced cast or ductile iron flanges.

.2 Higher pressure rated flanges as required to mate with equipment when equipment flange is of higher pressure rating than required for piping.

2.3 Welding

.1 Welding materials shall be in accordance with CSA W48.

2.4 Gasket Lubricant

.1 Lubricant shall be supplied by pipe manufacturer and no substitute or “or-equal” will be allowed.

2.5 Fabrication

.1 Mark each pipe length on outside:

.1 Size or diameter and class

.2 Manufacturer's identification and pipe serial number

.3 Location number on laying Drawing

.4 Date of manufacture

.2 Code markings according to approved Shop Drawings.

.3 Flanged pipe shall be fabricated in the shop, not in the field, and delivered to the Site with flanges in place and properly faced.

2.6 Finishes

.1 Factory prepare, prime, and finish coat in accordance with Pipe Data Sheet(s), and Section 09870 – Coating Systems for Steel Pipes.

3. EXECUTION

3.1 Piping Material Selection

.1 Piping material shall be epoxy lined and coated steel.

3.2 Preparation

.1 Notify Contract Administrator at least two (2) weeks prior to field fabrication of pipe or fittings.

.2 Inspect pipe and fittings before installation, clean ends thoroughly, and remove foreign matter and dirt from inside.

.3 Damaged Coatings and Linings: repair using original coating and lining materials in accordance with Manufacturer's instructions.

3.3 Welding

.1 Perform in accordance with Section IX, ASME Boiler and Pressure Vessel Code and ASME B31.1, B31.3 and B31.9 for Pressure Piping, as may be specified on Piping Data Sheets, and if recommended by piping or fitting Manufacturer

.2 Weld Identification: mark each weld with symbol identifying welder

.3 Pipe End Preparation:

.1 Machine Shaping: preferred

.2 Oxygen or Arc Cutting: smooth to touch, true, and slag removal by chipping or grinding

.3 Beveled Ends for Butt Welding: ANSI B16.25

.4 Surfaces:

.1 Clean and free of paint, oil, rust, scale, slag, or other material detrimental to welding.

.2 Clean stainless steel joints with stainless steel wire brushes or stainless steel wool prior to welding.

.3 Thoroughly clean each layer of deposited weld metal, including final pass, prior to deposition of each additional layer of weld metal with a power-driven wire brush.

.5 Alignment and Spacing:

.1 Align ends to be joined within existing commercial tolerances on diameters, wall thicknesses, and out-of-roundness.

.2 Root Opening of Joint: as stated in qualified welding procedure.

.3 Minimum Spacing of Circumferential Butt Welds: minimum four times pipe wall thickness or 25mm, whichever is greater.

.6 Climatic Conditions:

.1 Do not perform welding if there is impingement of any rain, snow, sleet, or high wind on the weld area, or if the ambient temperature is below 0°C.

.2 Stainless Steel and Alloy Piping: If the ambient is less than 0°C, local preheating to a temperature warm to the hand is required.

.7 Tack Welds: performed by qualified welder using same procedure as for completed weld, made with electrode similar or equivalent to electrode to be used for first weld pass, and not defective. Remove those not meeting requirements prior to commencing welding procedures.

.8 Surface Defects: chip or grind out those affecting soundness of weld.

.9 Weld Passes: as required in welding procedure.

.10 Weld Quality: free of cracks, incomplete penetration, weld undercutting, excessive weld reinforcement, porosity slag inclusions, and other defects in excess of limits shown in applicable piping code.

3.4 Installation-General

.1 Join pipe and fittings in accordance with Manufacturer's instructions, unless otherwise shown or specified.

.2 Remove foreign objects prior to assembly and installation.

.3 Flanged Joints:

.1 Install perpendicular to pipe centreline.

.2 Bolt Holes: straddle vertical centrelines, aligned with connecting equipment flanges or as shown.

.3 Use torque-limiting wrenches to ensure uniform bearing and proper bolt tightness.

.4 Plastic Flanges: install annular ring filler gasket at joints of raised-face flange.

.5 Raised-Face Flanges: use flat-face flange when joining with flat-faced ductile or cast iron flange.

.6 Verify compatibility of mating flange to adapter flange gasket prior to selecting grooved adapter flanging.

.7 Manufacturer:

.1 Same as pipe Manufacturer.

.2 Victaulic flange adapter.

.4 Grooved-End Joints:

.1 Type: rigid, except where joints are used to correct misalignment, to provide flexibility, and where shown otherwise, in which case provide flexible type.

3.5 Pipe Coatings

.1 Provide epoxy coating and lining on piping as indicated on the piping data sheet(s).

.2 Shop apply coating and lining to the greatest extent possible. Touch up coating and linings in the field as required. Minimize the number of field welds and use only where shown on approved shop drawings. Apply coating and lining to field welds and meet the same surface preparation, coating and testing requirements as shop welds.

.3 Before applying coatings and linings to metal piping, grind and round off all sharp edges, maximum radius of edges: 6mm.

.4 All interior epoxy coatings shall conform to NSF Standard 61 – Drinking Water System Components, suitable for use in potable water applications. Coating materials and application shall be in accordance with Section 09870 – Coating Systems for Steel Pipes.

.5 Colour of top coat: As selected by Contract Administrator from a set of standard colours which shall include white.

3.6 Installation-Buried Pipe

.1 Joints:

.1 Dissimilar Buried Pipes: Supply and install flexible mechanical compression joints for pressure pipe.

.2 Concrete Encased or Embedded Pipe: do not encase joints in concrete unless specifically shown.

.2 Placement:

.1 Keep trench dry until pipe laying and joining are completed.

.2 Prepare pipe base materials in uniform layers to the specified grades to receive pipe. Stabilized fill will be required when pipe emerges from a pile foundation structure.

.3 Exercise care when lowering pipe into trench to prevent twisting or damage to pipe.

.4 Measure for grade at pipe invert, not at top of pipe.

.5 Excavate trench bottom and sides of ample dimensions to permit visual inspection and testing of entire flange, valve, or connection.

.6 Prevent foreign material from entering pipe during placement.

.7 Close and block open end of last laid pipe section when placement operations are not in progress and at close of day's Work.

.8 Prevent uplift and floating of pipe prior to backfilling.

.3 Tolerances:

.1 Deflection From Vertical Grade: maximum 6 mm.

.2 Joint Deflection: maximum of 75% of Manufacturer's recommendation.

.3 Horizontal position of pipe centreline on alignment around curves maximum variation of 500 mm from position shown.

.4 Pipe Cover: minimum 2700 mm, unless otherwise shown.

3.7 Thrust Restraint

.1 Location:

.1 Buried Piping: where shown and where required to restrain force developed at pipeline tees, plugs, caps, bends, and other locations where unbalanced forces exist due to hydrostatic testing and normal operating pressure.

.2 Exposed Piping: at all joints in piping.

.2 Thrust Ties:

.1 Steel Pipe: attach with fabricated lugs.

.2 Ductile Iron Pipe: attach with socket clamps against a grooved joint coupling or flange.

.3 Flanged Coupling Adapters: for exposed installations, install Manufacturer's anchor studs through the coupling sleeve.

3.8 Interim Cleaning

.1 Prevent accumulation of weld rod, weld spatter, pipe cuttings and filings, gravel, cleaning rags, and other foreign material within piping during fabrication and assembly.

.2 Examine piping to assure removal of foreign objects prior to assembly.

.3 Shop cleaning may employ conventional commercial cleaning method if it does not corrode, deform, swell, or otherwise alter physical properties of material being cleaned.

3.9 Testing

.1 General:

.1 Conduct hydraulic pressure and leakage tests on new piping. Leak testing may be conducted off-site prior to shipment and installation.

.2 Supply and install necessary equipment and material and make taps in pipe, as required. Provide blind flanges as required.

.3 Contract Administrator will monitor the tests. Provide advance notice of start of testing.

.4 Test Pressures: As specified.

.5 Test Records: make records of each piping system installation during the test to document the following:

.1 Date of test

.2 Description and identification of piping tested

.3 Test fluid

.4 Test pressure

.5 Remarks, including:

.1 Leaks (type, location)

.2 Repairs made on leaks

.6 Certification by Contractor and signed acknowledgment by Contract Administrator that tests have been satisfactorily completed.

.2 Preparation and Execution:

.1 Buried Pressure Piping:

.1 Conduct final hydrostatic acceptance tests after trench has been completely backfilled.

.2 An initial service leak test may be conducted with a partially backfilled trench and the joints left open for inspection, if field conditions permit, as determined by the Contract Administrator.

.3 Expose joints for the acceptance test on buried pressure piping to be pneumatically tested or subjected to an initial service leak test.

.2 Exposed Piping: Conduct tests after piping has been completely installed including supports, hangers, and anchors, but prior to insulation.

.3 Hydrostatic Leak Tests:

.1 Equipment: Supply and install the following:

Description
Pressure gauges
Hydraulic force pump
Suitable hose and suction pipe as required

.2 Procedure:

.1 Use water as the hydrostatic test fluid.

.2 Provide clean test water of such quality as to minimize corrosion of the materials in the piping system.

.3 Open vents at high points of the piping system to purge air pockets while the piping system is filling.

.4 Venting during the filling of the system may also be provided by loosening flanges with a minimum of four bolts or by the use of equipment vents.

.5 Test piping systems at the test pressure of 1.5 times the duty pressure.

.6 Maintain hydrostatic test pressure continuously for thirty (30) minutes minimum and for such additional time as necessary to conduct examinations for leakage.

.7 Examine joints and connections for leakage.

.8 The piping system, exclusive of possible localized instances at pump or valve packing, shall show no visual evidence of weeping or leaking.

.9 Correct visible leakage and retest to satisfaction of the Contract Administrator.

.10 Repair leaks and retest system until no further leakage is evident.

3.10 Field Finishing

.1 Notify Contract Administrator at least three (3) days prior to start of any surface preparation or coating application work.

.2 As specified in Section 09870 – Coating Systems for Steel Pipes.

3.11 Field Quality Control

.1 Minimum Duties of Welding Inspector:

.1 Job material verification and storage.

.2 Qualification of welders.

.3 Certify conformance with approved welding procedures.

.4 Maintenance of records and preparation of reports in a timely manner.

.5 Notification to Contract Administrator of unsatisfactory weld performance within twenty four (24) hours of weld test failure.

.2 Required Weld Examinations:

.1 Perform examinations in accordance with Piping Code**:** ASME B31.3. 10% of the circumferential butt welds shall be random radiographed. For concrete encased steel pipes and pipes under foundations, provide radiographic examination of 50% of welds as selected by the Contract Administrator.

.2 Perform examinations for every pipe thickness and for each welding procedure, progressively, for all piping covered by this section.

.3 Examine at least one (1) of each type and position of weld made by each welder or welding operator.

.4 For each weld found to be defective under the acceptance standards or limitations on imperfections contained in the applicable Piping Code, examine two additional welds made by the same welder that produced the defective weld. Such additional examinations are in addition to the minimum required above. Examine, progressively, two (2) additional welds for each tracer examination found to be unsatisfactory.

3.12 Supplements

.1 Data Sheets.

Number	Title
15200-01	Carbon Steel Pipe and Fittings-Large Diameter

END OF SECTION

DATA SHEET – CARBON STEEL PIPE AND FITTINGS – LARGE DIAMETER

Item	Size	Description
Pipe	All	Manufactured in accordance with AWWA C200, except as herein modified. Fabricated from carbon steel sheet ASTM A1011 (Grades 30, 33, 36 or 40), A907 (Grade 36), or from plate ASTM A36, A283 (Grades C or D), or coil ASTM A139 (Grades B or C). Maximum carbon content of 0.25 percent. Minimum elongation of 22 percent in a 50.4 mm gauge length. Longitudinal and girth seams, whether straight or spiral, shall be butt welded using an approved electric-fusion-weld process.
	Welded and grooved: 1200 mm	 1219 mm outside dia., 9.5 mm min. wall thickness
Linings	All	Shop-Applied Liquid Epoxy Lining: Apply in strict accordance with manufacturer's instructions and requirements of AWWA C210 and Section 09870, including surface cleaning and preparation. For pipe interior, follow System 1, as specified in Section 09870.
Coatings	All	For exposed piping, follow System 5, as specified in Section 09870.
	All	For buried piping, apply coating in accordance with AWWA C214 consisting of at least four layers: 1. Primer layer. 2. Inner Layer Tape: Corrosion-protective tape, 0.5 mm (20 mils), with black exterior. 3. Outer Layer Tape: Mechanical protective tape, 0.76 mm (30 mils), with gray exterior. 4. Outer Layer Tape: Mechanical protective tape, 0.76 mm (30 mils), with white exterior. Total tape thickness minimum 2.0 mm (80 mils). Hold back minimum of 60 mm from end of pipe for welded joints.
	All	For concrete encased piping, tape wrap as specified above for buried piping; or alternatively, follow System 5, as specified in Section 09870.

DATA SHEET – CARBON STEEL PIPE AND FITTINGS – LARGE DIAMETER

Item	Size	Description
Joints	All	Exposed: Flanged, butt-welded or restrained flexible coupling. Where shown, provide grooved end meeting the requirements of AWWA C606. Buried or Concrete Encased: Field-welded butt strap or lap welded; AWWA C200, suitable for at least 700 kPa service and, regardless of type, shall be designed to be self-centering. Both bell and spigot ends shall be sized to provide a difference in circumferential measurement between the outside circumference of the spigot and the inside circumference of the bell of not less than 2.3 mm and not more than 12.4 mm.
Fittings	1200 mm	Fabricated: Carbon steel fabricated from pipe in accordance with AWWA C208; suitable for butt welding, elbows to have a 22.5-degree maximum mitre section angle, minimum of three sections; wyes, tees, crosses, and outlets to be reinforced in accordance with AWWA M11. Formed Fittings: Wrought carbon steel butt-welding type, ASTM A234/A234M, Grade WPB meeting the requirements of ANSI B16.9; fitting wall thickness to match adjoining pipe; long radius elbows unless shown otherwise. Grooved End: Malleable iron ASTM A47 or ductile iron ASTM A536, grooved ends to accept couplings without field preparation, EPDM elastomers for potable water service, rigid style coupling or as otherwise noted. Victaulic Style 44; Grinnell. Supply and install Type “D” Vic-ring. Coupling and “D” Vic-Ring shall be supplied by the manufacturer as a package.
Pipe Couplings	1200 mm	Victaulic Depend-O-Lok, AWWA C221, EPDM elastomer, epoxy coated steel or 316 stainless steel wetted parts, restrained (FxF) or non-restrained coupling (FxE or ExE) as indicated on Drawings.
Flanges	1200 mm	Steel, AWWA C207, Class D, ANSI B16.5, slip-on, flat faced.
Blind Flanges	All	Steel, AWWA C207, thickness to suit Class D unless otherwise noted.

DATA SHEET – CARBON STEEL PIPE AND FITTINGS – LARGE DIAMETER

Item	Size	Description
Bolting	Exposed piping	Flanges: Carbon steel ASTM A307, Grade B threaded studs, and ASTM A563, Grade A hex head nuts. Use 3 mm undersize bolting material for insulating flanges. Grooved End Couplings: Carbon steel, ASTM A183 bolts and nuts, 760 MPa minimum tensile strength.
	Submerged and underground piping	General Conditions: Type 316, ASTM A193/A193M, Grade B8M hex head bolts and ASTM A194/A194M Grade 8M hex head nuts.
Gaskets	All flanges	Water Service: 3.2 mm thick, black neoprene, full face type. Grooved Couplings: EPDM per ASTM D2000 for water and air to 110°C.

Notes: 1. Design and install pipe in accordance with AWWA M11, Steel Pipe - A Guide for Design and Installation.

END OF SECTION

ELECTRICAL GENERAL REQUIREMENTS

1. GENERAL

1.1 Work Included

.1 Complete and operational electrical system as required by the Drawings and as herein specified.

1.2 Drawings and Specifications

.1 The General Conditions, Supplementary Conditions, and Division 1 are a part of this Specification and apply to this Division.

.2 The intent of the Drawings and Specifications is to include all labour, products, and services necessary for complete Work, tested and ready for operation.

.3 Symbols used to represent various electrical devices often occupy more space on the Drawing than the actual device does when installed. In such instances, do not scale locations of devices from electrical symbols. Install these devices with primary regard for usage of wall space, convenience of operation and grouping of devices.

.4 Consider these Specifications and the Drawings and Specifications of all other Divisions as an integral part of the accompanying Drawings. Any item or subject omitted from either the Specifications, or the Drawings, but which is mentioned or reasonably specified in and by the others, shall be considered as properly and sufficiently specified and shall be supplied and installed.

.5 Provide all minor items and work not shown or specified but which are reasonably necessary to complete the Work.

.6 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.

1.3 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 the Canadian Electrical Code, CSA Standard C22.1 and the applicable building codes. Do Underground Systems in accordance with CAN/CSA-C22.3 No. 7 except where specified otherwise.

.3 Quality of Work specified and/or shown on the Drawings shall not be reduced by the foregoing requirements.

.4 Give all required notices, submit Drawings, obtain all permits, licenses and certificates and pay all fees required for this Work.

.5 Furnish a certificate of final inspection and approvals from inspection authority to the Contract Administrator.

.2 Standard of Workmanship:

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

.2 Employ a competent supervisor and a sufficient number of licensed tradesmen to complete the Work in the required time.

.3 Arrange and install products to fit properly into designated building spaces.

.4 Unless otherwise specified or shown, install products in accordance with recommendations and ratings of Manufacturers.

1.4 Submittals

.1 See Section 01300 – Submittals.

1.5 Record Drawings

.1 Refer to Division 1.

1.6 Operation and Maintenance Manuals

.1 Refer to Section 01730 – Operation and Maintenance Manuals

1.7 Product Handling

.1 Use all means necessary to protect the products of this Division before, during and after installation and to protect products and installed work of all other trades.

.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.

.4 Remove dirt, rubbish, grease, etc. resulting from this Work from all surfaces, including the inside of all cabinets, equipment enclosures, panelboard tubs, etc.

2. PRODUCTS

2.1 Quality of Products

.1 All products provided shall be CSA Approved, ULC approved where applicable, unless otherwise specified.

.2 If products specified are not CSA approved, 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.

2.2 Uniformity of Manufacture

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

2.3 Product Finishes

.1 Finish all cabinets, panelboards, switchboards, equipment cabinets, MCCs, etc. in ANSI 61 grey enamel unless otherwise specified.

.2 Apply primer on all items, which are to be finished on the job.

.3 Touch up all damaged painted finishes with matching lacquer, or, if required by the Contract Administrator, completely repaint damaged surface.

2.4 Use of Products during Construction

.1 Any equipment used for temporary or construction purposes shall be approved by the Contract Administrator. Clean and restore to "as new" condition all equipment prior to the time of Substantial Performance.

3. EXECUTION

3.1 Coordination with Other Divisions

.1 Examine the Drawings and Specifications of all Divisions and become fully familiar with their Work. Before commencing Work, obtain a ruling from the Contract Administrator if any conflict exists, otherwise no additional compensation will be made for any necessary adjustments.

.2 Lay out the Work and equipment with due regard to architectural, structural, process and mechanical features. Architectural and structural Drawings take precedence over electrical Drawings regarding locations of walls, doors and equipment.

.3 Do not cut structural members without approval of the Contract Administrator.

.4 Coordinate with all Divisions installing equipment and services, and ensure that there are no conflicts.

.5 Install anchors, bolts, pipe sleeves, hanger inserts, etc. in ample time to prevent delays.

.6 Examine previously constructed work and notify the Contract Administrator of any conditions, which prejudice the proper completion of this Work. Commencement of this Work without such notification constitute acceptance of other work.

3.2 Location of Outlets and Luminaires

.1 Electrical Drawings are, unless otherwise indicated, drawn to scale and approximate distances and dimensions may be obtained by scaling. Figured dimensions govern over scaled dimensions. Where exact dimensions and details are required, refer to Architectural and Structural Drawings.

.2 Outlet and equipment locations shown on the Drawings are approximate. Locations may be revised up to 3 m to suit construction and equipment arrangements without additional cost to the City, provided that the Contractor is notified prior to the installation of the outlets, or equipment.

.3 Maintain luminaire locations wherever possible. Notify the Contract Administrator of conflicts with other services.

.4 Unless otherwise specified or shown, install products in accordance with recommendations and ratings of Manufacturers.

3.3 Separation of Services

.1 Maintain separation between electrical wiring system and building piping, ductwork, etc. so that wiring system is isolated (except at approved connections to such systems) to prevent galvanic corrosion.

.2 In particular, contact between dissimilar metals, such as copper and aluminum, in damp or wet locations is not permitted.

3.4 Equipment Identification

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

NAMEPLATE SIZES

Size 1	10 x 50 mm	1 line	3 mm high letters
Size 2	12 x 70 mm	1 line	5 mm high letters
Size 3	12 x 70 mm	2 lines	3 mm high letters
Size 4	20 x 90 mm	1 line	8 mm high letters
Size 5	20 x 90 mm	2 lines	5 mm high letters
Size 6	25 x 100 mm	1 line	12 mm high letters
Size 7	25 x 100 mm	2 lines	6 mm high letters

.1 Distribution Centres (Indicate designation, bus capacity, voltage)

.2 MCCs (designation, voltage)

.3 Starters, contactors, disconnects (designation, voltage, load controlled)

.4 Panelboard (designation, voltage, bus capacity)

.5 Automatic transfer switch (designation, voltage, rating)

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

.7 Transformers (designation, capacity, primary and secondary voltage)

.2 Color code exposed conduits (including conduits above T-bar ceilings), junction and pull boxes, and metallic sheathed cables with paint or plastic tape (25 mm wide band) at 15 m intervals. Color coding to be as follows:

SYSTEM	MAJOR BAND	MAJOR BAND
347/600 V Normal	Dk. Blue	
120/208 V Normal	Lt. Blue	
UPS System	Lt. Blue	White
Fire Alarm System	Red	
Telephone	Lt. Green	
Building Alarm	Pink	
Intercom Systems	Purple	Green
Security Systems	Dk. Green	Lt. Brown
Door Intercom/Video	Purple	Yellow

.3 Provide neatly typed circuit directories in panelboards to indicate the area or equipment controlled by each branch circuit.

.4 Identify all conductors by coloured insulation and permanent markers at every terminal and accessible points throughout its entire run, as per the Canadian Electrical Code.

.5 Conductors:

.1 Equipment Grounding – Green

.2 Neutral Conductor – White

Fire Alarm System	
Neutrals	White
Switch Legs	Phase Colour with White Tracer
Speaker Cct.	Blue with Yellow Tracer
Box Circuit	Black with Yellow Tracer
Annunciator	Brown with Yellow Tracer

.6 Place cable metal identification markers bearing the equipment tag number on all Teck cables on both ends and all locations where the cable leaves the cable tray or penetrates a concrete wall.

.7 Install red plastic warning tape, 300 mm below grade, above all underground ducts.

.8 Provide permanent, corrosion resistant warning markers, suitable to the local inspection authority, imbedded in the surface of concrete slabs, which are directly above high voltage cables and duct banks.

3.5 Testing

.1 Refer to Section 16980 – Testing, Adjusting and Balancing of Electrical Equipment and Systems.

3.6 Access Panels

.1 Where electrical equipment, junction boxes, remote ballasts or the like are concealed, supply access panels. Use panels of adequate size for servicing of the electrical Work and complete with necessary frames and hinged doors held closed with captive fasteners. Coordinate type and size of panels with the Contract Administrator.

.2 In removable ceiling areas, provide markers on ceiling tile to locate equipment requiring access. Use markers of a type approved by the Contract Administrator.

3.7 Mounting Heights

.1 Unless a conflict exists, use the following as mounting heights from finished floors to centre of device.

Receptacles in Mechanical Rooms and Process Areas	1000 mm
Receptacles and Telephone Outlets in offices and control rooms	300 mm
Light Switches	1400 mm
Fire Alarm Manual Stations	1400 mm
Fire Alarm Bells	2100 mm
Clocks	2100 mm
Television and Computer Outlets	300 mm
Intercom	1400 mm
Thermostats	1400 mm
Door Entry Push-Buttons	1400 mm
Wall-mounted speakers	2100 mm
Panelboards, starters, and disconnects (to top of cover)	2000 mm
End of Line Resistors	1800 mm
Outlets above Counters	175 mm above countertop or backsplash

3.8 Sealing of Wall and Floor Openings

.1 Seal all conduit and cable entries through outside walls of buildings, through partition walls separating electrical rooms from other areas, through fire separations, and through floors above grade to prevent passage of moisture, dust, gasses, flame, or to maintain pressurization.

.2 Seal openings when all wiring entries shown on the Drawings have been completed.

.3 Sealing material fire resistant and not containing any compounds, which will chemically affect the wiring jacket or insulating material. Seal cable penetrations through fire separations.

3.9 Housekeeping Pads

.1 Mount all floor mounted electrical equipment installed by this Division on concrete housekeeping pads, which, unless otherwise noted, shall be the responsibility of this Division.

.2 Determine the extent of the housekeeping pads required and supply all information and details as to size and locations to the Contract Administrator within thirty (30) Calendar Days after the award of Contract.

3.10 Sleeves

.1 Provide sleeves of galvanized steel pipe with machine cut ends of ample size to accommodate conduits passing through walls, partitions, ceilings, floors, etc.

.2 For wall, partitions and ceilings ensure the ends are flush with the finish on both sides, but for floors extend 100 mm above finished floor level.

.3 Fire stop opening with ULC approved assembly for the installation conditions. Mount lamacoid indicating assembly requirements by penetration. Include assembly details in O&M Manuals.

.4 Locate and position sleeves exactly prior to construction of walls, floors.

.5 Failure to comply with the above requirements shall be remedied at this Division's expense.

3.11 Temporary Lighting and Power

.1 Provide grounded extension cords and temporary lights required for electrical Work.

.2 Coordinate with Contractor for obtaining temporary power service.

.3 If City operations will be affected by any power outage required for this work, give adequate notice to the City and do not interrupt power until approval has been obtained.

.4 Give adequate notice to other Divisions of any power outage required for this Work. Schedule outages to provide least interference with other Work.

END OF SECTION

SCOPE OF ELECTRICAL WORK

1. GENERAL

.1 Supply and install all material, equipment, wiring and labour necessary for the installation of the systems detailed on the Drawings and included in the Specifications in accordance with the latest edition of the Canadian Electrical Code.

.2 All areas inside the surge tower including the ladder access are classified as Category 1 wet locations. All materials and installation methods shall be suitable for the environment. The electrical room at the base of the tower is classified as an ordinary location.

2. WORK INCLUDED

2.1 General Requirements

.1 General Clean-up.

.2 All inspection and other permits, licenses required by various Inspection Agencies and local regulations related to Electrical Trade.

.3 Special testing or inspection, additional to the above as specified or covered by a Cash Allowance.

.4 Scaffolding.

.5 Shop Drawings.

.6 Project Record Documents (As-Built Drawings) where specified.

.7 O&M Data, where specified.

2.2 Specific Requirements Included But Not Limited to the Scope of Work

.1 Provide direct buried cables from 600 V non-essential MCC located in DBPS building to the distribution panel.

.2 Supply and install 40A, 3P breaker in non-essential MCC located in DBPS building.

.3 Provide 600 V power distribution panel, transformer, 120/208 V panel board, lighting and heating as indicated on the Drawings.

.4 Provide lightning protection on surge tower.

.5 Disconnect electrical and phone service to existing site trailer. Reconnect services at new location.

END OF SECTION

INSTALLATION OF CABLES IN TRENCHES AND IN DUCTS

1. GENERAL (NOT USED)

2. PRODUCTS

2.1 Cable Protection

.1 Provide 600 mm x 600 mm x 50 mm concrete patio blocks above directed buried duct banks. Patio blocks to be coloured RED for identification.

2.2 Markers

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

3. EXECUTION

3.1 Direct Burial of Cables

.1 After sand bed specified in Division 2 is in place, lay cables maintaining 75 mm clearance from each side of trench to nearest cable. Do not pull cable into trench.

.2 Provide offsets for thermal action and minor earth movements. Offset cables 150 mm for each 60 m run, maintaining minimum cable separation and bending radius requirements.

.3 Make termination and splice only as indicated leaving 0.6 m of surplus cable in each direction.

.1 Make splices and terminations in accordance with Manufacturer's instructions using approved splicing kits.

.4 Underground cable splices not acceptable.

.5 Minimum permitted radius at cable bends for rubber, plastic or lead covered cables, 8 times diameter of cable; for metallic armoured cables, 12 times diameter of cables or in accordance with Manufacturer's instructions.

.6 Maintain 75 mm minimum separation between cables of different circuits. Maintain 300 mm horizontal separation between low and high voltage cables. When low voltage cables cross high voltage cables maintain 300 mm vertical separation with low voltage cables in upper position. At crossover, maintain 75 mm minimum vertical separation between low voltage cables and 150 mm between high voltage cables. Maintain 300 mm minimum lateral and vertical separation for fire alarm and control, cables when crossing other cables, with fire alarm and control cables in upper position. Install treated planks on lower cables 0.6 m in each direction at crossings.

.7 After sand protective cover is in place, install continuous row of concrete patio as indicated to cover length of run.

3.2 Cable Installation in Ducts

.1 Install cables as indicated in ducts.

.2 Do not pull spliced cables inside ducts.

.3 Install multiple cables in duct simultaneously.

.4 Use CSA approved lubricants of type compatible with cable jacket to reduce pulling tension.

.5 To facilitate matching of colour coded multiconductor control cables reel off in same direction during installation.

.6 Before pulling cable into ducts and until cables properly terminated, seal ends of lead covered cable with wiping solder; seal ends of non-leaded cables with moisture seal tape.

.7 After installation of cables, seal duct ends with duct sealing compound.

3.3 Field Quality Control

.1 Perform tests in accordance with Section 16980 – Testing, Adjusting and Balancing of Electrical Equipment and Systems.

.2 Perform tests using qualified personnel. Provide necessary instruments and equipment.

.3 Check phase rotation and identify each phase conductor of each feeder.

.4 Check each feeder for continuity, short circuits and grounds. Ensure resistance to ground of circuits is not less than 50 megohms.

.5 Pre-acceptance test for cables under 1000 V.

.1 After installing cable but before splicing and terminating, perform insulation resistance test with 1000 V megger on each phase conductor.

.2 Check insulation resistance after each splice and/or termination to ensure that cable system is ready for acceptance testing.

.6 Pre-acceptance test for cables over 1000 V.

.1 After installing cable but before splicing and terminating, perform insulation resistance test with 5000 V megger on each phase conductor.

.2 Check insulation resistance after each splice and/or termination to ensure that cable system is ready for acceptance testing.

.7 Acceptance Tests

.1 Ensure that terminations and accessory equipment are disconnected.

.2 Ground shields, ground wires, metallic armour and conductors not under test.

.8 Acceptance Tests for cables over 1000 V

.1 High Potential (Hipot) Testing.

.1 Conduct Hipot testing at 200% of original factory test voltage in accordance with Manufacturer's or IPCEA recommendations.

.2 Leakage Current Testing.

.1 Raise voltage in steps from zero to maximum values as specified by IPCEA Manufacturer for type of cable being tested.

.2 Hold maximum voltage for specified time period by IPCEA or Manufacturer.

.3 Record leakage current at each step.

.9 Provide Contract Administrator with list of test results showing location at which each test was made, circuit tested and result of each test.

.10 Remove and replace entire length of cable if cable fails to meet any of test criteria.

END OF SECTION

CONDUITS, CONDUIT FASTENINGS AND CONDUIT FITTINGS

1. GENERAL

1.1 Work Included

.1 Provide a complete system of conduit and fittings for installation of wiring.

2. PRODUCTS

2.1 Rigid Steel Conduit

.1 Galvanized with threaded joints and connections.

.2 Connections in dry locations: steel or malleable iron locknuts inside and outside enclosures. Insulated bushings Thomas & Betts Series 222.

.3 Connectors subjected to moisture interior and exterior: liquid and dust tight with insulated throat, Thomas & Betts "Bullet Hub" 370 Series.

.4 Fittings: cast metal "Condulet" as manufactured by Crouse-Hinds Canada Ltd. including gasketted covers in damp locations.

.5 Expansion joints: cast metal Crouse-Hinds type XJ or approved alternate.

2.2 EMT Conduit

.1 Conduit: galvanized electrical metallic tubing.

.2 Fittings: steel rain-tite connectors with insulated throat. Steel rain tite couplings.

2.3 Rigid PVC Conduit

.1 Conduit: rigid non-metallic conduit of unplasticized PVC as manufactured C.G.E. "Sceptre" Schedule 40.

.2 Fittings: threaded male or female solvent weld connectors and solvent weld couplings, as supplied by conduit Manufacturer.

.3 Solvent: as recommended by conduit Manufacturer.

.4 Use rigid steel epoxy coated elbows where exiting the slab

2.4 Flexible Conduit (Open Air)

.1 Conduit: spiral wound, interlocking flexible metal conduit.

.2 Connectors: slip-proof, insulated throat or non-metallic bushings, steel, Thomas & Betts Ltd. "Tite-Bite", Series 300.

2.5 Flexible Conduit (Embedded in Slab)

.1 Plastic conduit ENT may be used in the slab

.2 For conduit slab exit, use rigid steel, epoxy coated elbows

2.6 Liquid-Tight Flexible Conduit

.1 Conduit: flexible metal conduit with liquid-tight PVC jacket. Industrial Wire & Cable "Liquiseal".

.2 Connectors: captive sealing jacket and ground cone insulated throat, steel (Thomas & Betts Ltd. "Super-Tight", Series 6000).

2.7 Rigid Aluminum Conduit

.1 Conduit: rigid extruded aluminum with threaded joints and connections and interior silicone coating to meet requirements of CSA C22.2 No. 45. Rigid metal conduit.

.2 Fittings: copper free cast aluminum conduit fittings for indoor and outdoor installations.

3. EXECUTION

3.1 Rigid Steel Conduit

.1 Use as raceways for following applications:

.1 In all areas exposed to weather.

.2 Locations where mechanical damage may occur and in mechanical rooms to a height of 1 m.

.3 Three phase motor wiring (Teck cable may also be used for this application where shown on the Drawings).

.4 In hazardous classified areas.

3.2 EM.T Conduit

.1 Use as raceways for following applications:

.1 For housing digital communications cables.

.2 In dry finished areas such as offices, and control rooms.

.2 It may not be used in any other areas.

3.3 Rigid PVC Conduit

.1 Use as raceways for following applications

.1 In poured concrete floors and walls and on underground runs exterior to the buildings unless otherwise noted.

.2 Wiring installed in areas subject to intermittent or continuous moisture but not surface mounted.

.3 Category 2 locations.

.4 Do not surface mount rigid PVC conduit.

.2 Use strictly in accordance with the Canadian Electrical Code. Do not use in return air plenums and for exit and fire escape lights.

.3 Provide insulated ground wire in all rigid PVC conduits in accordance with the Canadian Electrical Code.

.4 Where rigid PVC conduit is set in poured concrete, solvent joints must be completed and allowed to set as per Manufacturer's instructions. Tie PVC conduit securely to prevent movement and broken joints from concrete pour and vibration.

.5 Bend rigid conduit in strict accordance with Manufacturer's directions. Distorted bends will not be accepted.

3.4 Flexible Conduit

.1 Use as raceways for following applications:

.1 Connections to fhp motors in dry locations.

.2 Flexible connections to luminaries, in dry areas such as offices, control rooms and similar finished locations.

.2 Provide a separate insulated ground wire in all flexible conduits.

3.5 Liquid-Tight Flexible Conduit

.1 Use as raceways for following applications:

.1 At all motors, pipe mounted control devices, luminaries in non classified plant process areas, and other devices subject to movement or vibration in non classified process areas.

.2 At all motors provide a short length before connecting to the motor terminal box. Minimum length shall be 450 mm plus 4 times the conduit diameter.

.3 Provide a separate ground wire within flexible conduit, bonded to motor frames and system ground.

3.6 Aluminum Conduit

.1 Use as a raceway for the following applications and as indicated on Drawings.

.1 In wet areas for surface conduit runs.

.2 Surface mounted in tank areas and exterior.

.2 Follow Manufacturer's recommendations for cutting, threading, reaming and bending.

.3 Use thread compound to prevent thread damage and ensure watertight connections. Do not use red or white lead paint.

.4 Do not install in poured concrete.

3.7 Workmanship

.1 Install all conduit and wiring concealed, unless otherwise shown on the Drawings. Do not recess conduit in columns, except as noted, without permission from the Contract Administrator.

.2 Where conduit is run exposed, run parallel to building lines. Where conduits are grouped (two or more), space evenly, make bends concentric and mount on Unistrut racks.

.3 Lay out conduit to avoid interference with other work. Maintain a minimum clearance of 150 mm from steam or hot water piping, vents, etc.

.4 Slabs on grade: Install rigid PVC conduit in the gravel base below concrete slabs. Transition to rigid steel conduit around stub-ups through slab and extend 150 mm beyond concrete. When rigid steel conduit is installed in contact with earth, protect using Polykin #940 tape. Extend taping 300 mm above finished grade.

.5 Metal conduit installations in concrete pours: Tie down conduit to prevent shifting. Make all joints tight to ensure ground continuity. To prevent concrete entry, pack outlet boxes and cap conduit terminations both in boxes and stub-ups. Apply Polykin #940 tape to the conduit 152 mm both sides of the point of leaving slab.

.6 Do not place conduit in concrete slabs in which slab thickness is less than four times conduit diameter. Place conduits larger than this size under floor. Conduits to have minimum 25 mm concrete cover, or as shown.

.7 Organize conduit in slabs to minimize crossovers. Obtain approval and minimum concrete cover required as per Division 3 prior to installing conduits in slabs.

.8 At all recessed panels cap 2 to 25 mm and 4 to 19 mm empty conduits from panel into ceiling above and below for future use.

.9 Where conduit is installed in floor slabs to run up at equipment or motors, carefully check all conduit locations. Verify conduit locations for mechanical equipment from Shop Drawings or detail Drawings. Brace all stub-ups. For stub-ups, use rigid steel.

.10 Where steel conduit is required to be bent, do not heat, and do not bend conduit in such a way as to reduce pipe cross section area at any point. Radii of bends shall be as per Canadian Electrical Code.

.11 For all runs of conduits, do not include more than equivalent of 4 - quarter bends. Provide conduit fittings, pullboxes and junction boxes where necessary. Do not use pulling elbows, except by special permission.

.12 Where possible, install conduits so that they are not trapped, cap turned up conduits to prevent the entrance of dirt of moisture during construction. Swab out conduit and thoroughly clean internally before wires and cables are pulled.

.13 Take extreme care in reaming ends of all conduit to ensure a smooth interior finish that will not damage the insulation of the wires.

.14 Use insulated non-metallic bushings on all conduit terminations.

.15 Ensure electrical continuity in all conduit systems.

.16 All conduit shown exposed in finished areas is to be free of unnecessary labels and trade marks.

.17 Install a 44 kg test line in all conduits left empty, including those in which others will pull cables, wires, etc.

.18 For conduits and ducts crossing building expansion joints, provide conduit expansion fittings to suit the type of conduit used, and shall be Crouse-Hinds, Sceptre, or approved fitting.

.19 Seal conduits with duct seal where conduits are run between heated and unheated areas. Where conduits, cables, or cable trays pierce fire separations, seal openings with Dow Corning 3-6548 sealant. Seal all conduits entering or leaving hazardous classified areas with approved seals.

.20 Where conduits pass through walls, group and install through openings. After all conduits shown on the Drawings are installed, close wall openings with material compatible with the wall construction. Review size and quantity of conduit sleeves with the Contract Administrator.

.21 Where Drawings show conduit designations, identify these conduits at each point of termination and at 50 m intervals with Thomas & Betts "Ty-Rap" No. TY532M labels.

.22 Where conduit finish is damaged, repair or replace.

.23 Use "Condulet" fittings for power and telephone type conduit terminations in lieu of boxes where support is not provided.

.24 All branch circuit wiring, home-runs, communication and data to be minimum 20 mm diameter unless otherwise stated.

.25 Provide necessary flashing and pitch pockets, making watertight joints where conduits pass through roof or watertight membranes.

.26 Where panelboard branch circuit conduits are amalgamated, do not exceed 25 mm diameter in size.

.27 Feed all conduit entries to motors, field devices, instruments, control stations, cabinets and panels in process areas from the side. Where this is not possible, permission must be obtained from the Contract Administrator for other means of entry. Maintain minimum 150 mm clearance above finished floor.

.28 Install sleeves and rough opening as required in advance of concrete pours.

.29 Sleeves shall extend 100 mm above floor or have concrete curbing to provide mechanical protection and water stop.

END OF SECTION

WIRES AND CABLE 0-1000V

1. GENERAL

1.1 Work Included

.1 Provide a complete system of wiring, making all connections necessary for the installation shown on Drawings.

1.2 References, Codes and Standards

.1 CSA C22.2 No. 0.3, Test Methods for Electrical Wires and Cables.

.2 Install and rate power cables in accordance with the Canadian Electrical Code requirements, or in accordance with ICEA requirements where permissible.

1.3 Product Data

.1 Submit product data in accordance with Section 16010 – Electrical General Requirements.

2. PRODUCTS

2.1 Building Wires

.1 Conductors: stranded for 10 AWG and larger. Minimum size: 12 AWG.

.2 Copper conductors: size as indicated, with 600 V insulation of chemically XLPE material rated RW90.

2.2 Teck Cable

.1 Conductors:

.1 Grounding conductor: copper

.2 Circuit conductors: copper, size as indicated

.2 Insulation:

.1 Chemically XLPE rated type RW90, 1000 V

.3 Inner jacket: PVC material.

.4 Armour: interlocking aluminum.

.5 Overall covering: thermoplastic PVC material.

.6 Fastenings:

.1 One hole malleable iron straps to secure surface cables 50 mm and smaller. Two hole steel straps for cables larger than 50 mm.

.2 Channel type supports for two or more cables at 1500 mm centers.

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

.7 Connectors:

.1 Watertight approved for TECK cable.

2.3 Control Cables

.1 Type LVT: 2 soft annealed copper conductors, sized as indicated, with thermoplastic insulation, and outer covering of thermoplastic jacket.

.2 Low energy 300 V control cable: solid stranded annealed copper conductors sized as indicated, with PVC insulation type TW with shielding of wire braid over each pair and overall covering of PVC jackets.

.3 600 V type: stranded annealed copper conductors, sizes as indicated with PVC insulation type R90, XLPE type with shielding of wire braid each pair of conductors and overall covering of thermoplastic jacket interlocked armour and jacket over sheath of PVC.

2.4 Luminaire Wire

.1 Type TEW: Copper conductors, #14 AWG, with thermoplastic and asbestos insulation, flame retardant, heat and moisture resistant, rated 600 V, 105^{o}C.

3. EXECUTION

3.1 General

.1 Minimum conductor size #12 AWG except for luminaire drops which can be #14 AWG if fed from 15A circuits.

3.2 Installation of Building Wires

.1 Install wiring as follows:

.1 In conduit systems in accordance with Section 16111 – Conduits, Conduit Fastenings and Conduit Fittings.

.2 In trenches in accordance with Section 16106 – Installation of Cables in Trenches and in Ducts.

3.3 Installation of Teck Cable 0 - 1000 V

.1 Install cables.

.2 Group cables wherever possible on channels.

.3 Install cable in trenches in accordance with Section 16106 – Installation of Cables in Trenches and in Ducts.

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

3.4 Installation of Aluminum Sheathed Cable

.1 Group cables wherever possible on channels.

.2 Install cable in trenches in accordance with Section 16106 – Installation of Cables in Trenches and in Ducts.

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

3.5 Installation of Control Cables

.1 Install control cables in conduit, underground ducts or by direct burial.

.2 Ground control cable shield.

3.6 Installation of Luminaire Wire

.1 Run wires from outlet boxes through luminaire raceways, splice and connect in raceways. Connect continuous rows of luminaires to circuit without breaking conductors.

3.7 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. Do not pull wires into incomplete conduit runs.

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

.3 Do not install any conductor smaller than #12 AWG, except where specifically indicated otherwise, i.e. for fire alarm system station circuits, P.A. wiring, etc.

.4 Provide sizes of conductors as shown on Drawings. Voltage drop from lighting panels to farthest outlet must not exceed 2% at full load in any case. Advise Contract Administrator if problem is foreseen.

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

3.8 Identification, Coding, and Balancing

.1 For branch circuit wiring, follow identification system shown on the Drawings and as specified in Section 16010 – Electrical General Requirements.

.2 Connect single phase equipment to minimize imbalance on feeders. Adjust branch circuiting shown as required for optimum balancing. Record all changes on Record Drawings.

.3 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 wraps of 3M #471 plastic film tape 48 mm wide.

.4 Conductors sized No. 10 and smaller are required to be factory coloured, not taped On-Site.

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

3.9 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

SPLITTERS, JUNCTION BOXES, PULL BOXES AND CABINETS

1. GENERAL

1.1 Work Included

.1 Provide a complete system of splitters boxes and cabinets for the installation of wiring and equipment.

1.2 Shop Drawings and Product Data

.1 Submit Shop Drawings and product data for cabinets in accordance with Section 01300 – Submittals and Section 16010 – Electrical General Requirements.

2. PRODUCTS

2.1 Junction Boxes and Pull Boxes, Weatherproof

.1 Materials:

.1 Cast steel, Crouse Hinds, WBJ Series.

2.2 Junction Boxes and Pull Boxes, Indoor Dry Locations

.1 Materials:

.1 Code gauge sheet steel, welded construction, phosphatized and factory paint finish.

.2 Components:

.1 For flush mounting, covers to overlap box by 25 mm minimum all around with flush head cover retaining screws.

.2 Use rolled edges for surface boxes.

.3 For junction boxes mounted in exterior walls, provide complete with box vapour barriers.

2.3 Junction Boxes in Hazardous Classified Areas

.1 Junction boxes in hazardous classified areas to be rated and marked for hazardous classification of location in which they are to be installed.

2.4 Cabinets

.1 Materials:

.1 Cabinets: Code gauge sheet steel, welded construction, phosphatized and factory paint finish, suitable for field painting.

.2 Locks: to match panelboards.

.2 Components:

.1 With hinged door and return flange overlapping sides, with handle, lock and catch for surface mounting, size as indicated or to suit.

.2 Install a back mounting plate for DIN rail mounted terminal blocks. Plate to be painted white enamel.

.3 Install metal divider in cabinets with more than one voltage.

.4 Surface or flush with trim and hinged door, latch and lock and two keys, size as indicated or to suit. Keyed to match panelboard keys 19 mm.

2.5 Splitters

.1 Materials:

.1 Code gauge sheet steel, welded construction, phosphatized and factory paint finish.

.2 Components:

.1 Formed hinged cover suitable for locking in the closed position.

.2 Main and branch lugs to match required size and number of incoming and outgoing conductors as indicated.

.3 At least three spare terminals on each set of lugs in splitters less than 400 A.

3. EXECUTION

3.1 Installation

.1 Junction Boxes and Pull Boxes:

.1 Supply all pull boxes and junction boxes shown on the drawings or required for the installation.

.2 Boxes installed in party walls to be offset by a minimum of one stud space.

.3 Install in inconspicuous but accessible locations, above removable ceilings or in electrical rooms, utility rooms or storage areas.

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

.5 Size in accordance with the Canadian Electrical Code, as a minimum.

.2 Cabinets:

.1 Mount cabinets with top not greater than 1980 mm above finished floor, coordinated with masonry, panelboards, fire hose cabinets and similar items. Securely fasten backboards to cabinet interiors.

.2 Install terminal block where indicated.

.3 Splitters

.1 Install splitters and mount plumb, true and square to the building lines.

.2 Extend splitters full length of equipment arrangement except where indicated otherwise.

.4 Identification

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

END OF SECTION

OUTLET BOXES, CONDUIT BOXES AND FITTINGS

1. GENERAL

1.1 Work Included

.1 Provide a complete system of boxes for the installation of wiring and equipment.

1.2 References

.1 CSA C22.1-Canadian Electrical Code, Part 1.

2. PRODUCTS

2.1 Outlet and Conduit Boxes General

.1 Size boxes in accordance with CSA C22.1.

.2 102 mm square or larger outlet boxes as required for special devices.

.3 Gang boxes where wiring devices are grouped.

.4 Blank cover plates for boxes without wiring devices.

.5 347 V outlet boxes for 347 V switching devices.

.6 Combination boxes with barriers where outlets for more than one system are grouped.

2.2 Outlet Boxes for Metal Conduit

.1 Materials:

.1 Surface or recessed concealed type: Die formed steel, hot dip galvanized, 1.25 oz/ft^2 minimum zinc coating.

.2 Surface mounting exposed: Cast ferrous for threaded conduit, with attached lugs, corrosion resistant two coats finish.

.2 Components:

.1 Ceiling outlets, surface mounting, concealed:

.1 101 mm square, depth 54 mm, Iberville 52171 series

.2 119 mm square, depth 54 mm, Iberville 72171 series

.2 Ceiling outlets, concealed mounting in concrete:

.1 101 mm octagonal concrete rings, depth from 38 mm to 152 mm Iberville 54521 series.

.2 Extension ring to change from recessed conduit to exposed conduit, 101 mm octagonal, 38 mm deep square Iberville 53151-1/2 or 38 mm deep octagonal Iberville 51151C or 54 mm deep, Iberville 55171C.

.3 Wall boxes, concealed in concrete or masonry: for one and two gang applications: 101 mm square, 54 mm deep, 52171 series complete with suitable 52-C-49 series square cornered raised tile wall cover for proper device and wall surface application. Masonry boxes may be used for line voltage switching.

.4 Wall outlets, concealed non-masonry construction, with plaster finish: For one or two gangs used with switches, receptacles, etc., use 54 mm deep Iberville 52171 series, with matching plaster covers, depth to suit. Alternately, use 119 mm square boxes, Iberville 72171 series and covers as required. (For more than two gangs use solid boxes Iberville GSB series with GBC series cover, or special boxes as required).

.5 Wall outlets, surface, exposed mounting or used for outdoor outlets: One or more gang, Crouse-Hinds FS series or FD series, condulet.

.6 Floor Outlets, concealed: Of a type adjustable after box secured, permanently watertight concrete type, sheet steel, T & B #1963.

.7 Covers: Unless wiring devices and plates are mounted, provide blank, round canopy covers to match boxes.

.8 For 347 V switches: Non-interchangeable with 120 V switches through special tapped mounting ears, with top and bottom knockouts only, Iberville #1110-HV Series or Iberville MBX-1-HV, or MBD-1-HV Series.

2.3 Outlet Boxes for Rigid PVC Conduit

.1 Materials:

.1 Rigid PVC boxes and fittings: Unplasticized PVC.

.2 Components:

.1 Floor boxes: Round with threaded hubs for threaded female connectors.

2.4 Masonry Boxes

.1 Electro-galvanized steel masonry single and multi-gang boxes for devices flush mounted in exposed block walls.

2.5 Concrete Boxes

.1 Electro-galvanized sheet steel concrete type boxes for flush mount in concrete with matching extension and plaster rings as required.

2.6 Conduit Boxes

.1 Cast FS or FD aluminum boxes with factory-threaded hubs and mounting feet for surface wiring of switches and receptacle.

2.7 Fittings - General

.1 Bushing and connectors with nylon insulated throats.

.2 Knock-out fillers to prevent entry of debris.

.3 Conduit outlet bodies for conduit up to 32 mm and pull boxes for larger conduits.

.4 Double locknuts and insulated bushings on sheet metal boxes.

3. EXECUTION

3.1 Installation

.1 Support boxes independently of connecting conduits.

.2 Fill boxes with paper, sponges or foam or similar approved material to prevent entry of debris during construction. Remove upon completion of work.

.3 For flush installations mount outlets flush with finished wall using plaster rings to permit wall finish to come within 6 mm of opening.

.4 Provide correct size of openings in boxes for conduit, mineral insulated and armoured cable connections. Reducing washers are not allowed.

.5 Install all outlets flush and surface mounted as required for the installation.

.6 Surface mount above suspended ceilings, or in unfinished areas.

.7 Adjust position of outlets in finished masonry walls to suit course lines. Coordinate cutting of masonry walls to achieve neat openings for all boxes.

.8 Do not distort boxes during installation. If boxes are distorted, replace with new boxes.

.9 Use plaster rings to correct depth. Use 30 mm on concrete block.

.10 Do not use sectional boxes.

.11 Provide boxes sized as required by the Canadian Electrical Code.

.12 Install vapour barrier material to surround and seal all outlet boxes located on exterior walls of building. Maintain wall insulation.

.13 Outlets installed in party walls to be offset by a minimum of one stud space.

.14 Provide ceiling outlet boxes for every surface mounted fixture or row of fixtures installed on suspended "hard" ceilings.

.15 Primary bushings in termination box for cable connection.

.16 Secondary bushings in termination box for bus duct connection.

.17 Control junction box.

.18 Stainless steel nameplate and connection diagram.

.19 Identify all boxes in accordance with Section 16010 – Electrical General Requirements.

END OF SECTION

WIRING DEVICES

1. GENERAL

1.1 Work Included

.1 Provide and connect all wiring devices for the complete installation.

2. PRODUCTS

2.1 Manufacturer

.1 Wiring devices to be of one Manufacturer throughout the Work.

.2 Manufacturer's shall be Hubbell, Smith and Stone, Bryant, or Pass & Seymour.

2.2 Devices

.1 The catalogue numbers shown below are for the particular Manufacturer's series and all necessary suffixes shall be added for the requirements as stated. For all devices, use the specification grade minimum, and wherever possible, use devices of the same manufacture.

.2 Devices to be ivory with stainless steel coverplates in all but mechanical areas unless noted otherwise. Use galvanized steel coverplates in mechanical areas and for surface mounted devices.

2.3 Switches

.1 347 V, 20 A, single and double pole, three and four-way: As Hubbell No.18221, 18222, 18223 and 18224.

.2 120 V, 20 A, single and double pole, three and four-way: As Hubbell No. 1221, 1222, 1223 and 1224.

.3 For wet locations use the following switches: 20 A, 120 V single pole ivory, and side wired press-switch, as Hubbell #1281.

.4 Provide manually - operated general purpose AC switches with the following features:

.1 Terminal holes approved by AWG #10 wire.

.2 Silver alloy contacts.

.3 Urea or melamine molding for parts subject to carbon tracking.

.4 Suitable for back and/or side wiring.

2.4 Receptacles

.1 Duplex 20 A, 120 V, 3 wire, ivory, U-ground, as Hubbell No. 6252, with the following features:

.1 Ivory urea molded housing.

.2 Suitable for #10 AWG for back and side wiring.

.3 Eight back wired entrances, four side wiring screws.

.4 Break-off links for use as split receptacles.

.5 Triple wipe contacts and rivetted grounding contacts

.6 Dual 15/20 A configuration.

.2 Duplex 15 A, 120 V, 3 wire, ivory, U-ground ground fault receptacle, as Hubbell No. GF-52621A.

.3 Single 15 A, 120 V, 3 wire clock receptacle with stainless steel plate, as Hubbell No. 5235.

.4 Single 30 A, 250 V, 4 wire receptacle with stainless steel cover, as Hubbell No. 9430.

.5 Single 50 A, 250 V, 4 wire range receptacle with stainless steel cover, as Hubbell No. 9450.

.6 Floor outlets, as Smith and Stone VIP Series or Odessey Controls Modular System c/w frames, as required, and receptacles and outlets, as indicated.

2.5 600 V Interlocked Receptacles

.1 Interlocked receptacle with enclosed disconnect switch.

.2 NEMA 4X enclosure complete with viewing window.

.3 30 Amp rating, or as specified on Drawings.

.4 NEMA type HD heavy duty 3 pole safety switch.

.5 3 wire, 4 pole receptacle.

.6 Crouse-Hinds Arktite WSRD series.

2.6 Coverplates

.1 Provide coverplates for all wiring devices, including but not limited to receptacles, telephone, computer, and television.

.2 Use sheet steel utility box cover for wiring devices installed in surface mounted utility boxes.

.3 Use stainless steel 1 mm thick coverplates on all wiring devices mounted in flush-mounted outlet boxes unless otherwise specified.

.4 Weatherproof double lift spring - loaded cast aluminum coverplates, complete with gaskets for single receptacles or switches.

.5 Weatherproof spring - loaded cast aluminum coverplates complete with gaskets for single receptacles or switches.

.6 Use gasketted DS cast covers on FS and FD type boxes.

.7 For all 347 V switch plates, use stainless steel with the voltage pressed or engraved on the plate.

3. EXECUTION

3.1 Installation

.1 Install single throw switches with handle in the "UP" position when switch closed.

.2 Install switches vertically in gang type outlet box when more than one switch is required in one location.

.3 Mount switches on the latch side of the doorway as close as possible to door frame unless otherwise indicated on drawings.

.4 Install receptacles vertically in gang type outlet box when more than one receptacle is required in one location.

.5 Protect cover plate finish with paper or plastic film until all painting and other work is finished, then remove paper.

.6 Install suitable common coverplates where wiring devices are grouped. Do not distort plates by tightening screws excessively.

.7 Do not use coverplates meant for flush outlet boxes on surface mounted boxes.

.8 Wherever possible, mount equipment in a straight line at a uniform mounting height, coordinated with other equipment and materials.

.9 Mounting dimensions are to the centre of the devices. Final instructions on mounting heights shall be given by the Contract Administrator at the Site. The dimensions given in Section 16010 – Electrical General Requirements shall be used as a guide, but is subject to final verification prior to installation.

.10 Supply and install a separate neutral conductor from branch circuit panel to devices for all dimmer control circuits.

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 installation shown on Drawings.

1.2 Special Codes

.1 Install and rate power cables in accordance with the Canadian Electrical Code requirements or in accordance with IPCEA requirements where permissible.

1.3 References

.1 CSA C22.2 No. 65 Wire Connectors.

.2 EEMAC 1Y-2, Bushing Stud Connectors and Aluminum Adapters (1200 A 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 Fixture type splicing connectors: with current carrying parts same material as conductors sized to fit the conductors 10 AWG or less.

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

.1 Connector body and stud clamp for stranded or solid round copper conductors.

.2 Clamp for stranded copper conductors.

.3 Stud clamp bolts.

.4 Bolts for copper bar.

.5 Bolts for aluminum bar.

.6 Sized for conductors as indicated.

.4 Clamps or connectors for Teck cable and 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 #10 AWG and smaller motor connections. Tape with rubber and scotchtape. Lugs to accept ten - 32 x $^{3}/_{8}$" machine bolts.

.3 Terminate conductors #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 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 Manufacturer.

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

END OF SECTION

CONNECTORS AND TERMINATIONS

1. GENERAL

1.1 Inspection

.1 Obtain inspection certificate of compliance covering high voltage stress coning (if applicable) from the Contract Administrator and include it with As-Built Drawings and maintenance manuals.

1.2 Product Data

.1 Submit product data sheets in accordance with Section 16010 – Electrical General Requirements.

2. PRODUCTS

2.1 Connectors and Terminations

.1 Copper 2 hole long barrel compression connectors as required and sized for conductors.

.2 Contact aid for aluminum cables where applicable.

3. EXECUTION

3.1 Installation

.1 Install stress cones, terminations, and splices in accordance with the Manufacturer's instructions.

.2 Bond and ground as required.

END OF SECTION

GROUNDING

1. GENERAL

1.1 Description

.1 Supply and install a complete grounding system. Securely and adequately ground all components of the electrical system in accordance with the requirements of all related sections in the latest Canadian Electrical Code and the local Electrical Inspection Branch.

.2 The system to consist of cables, ground rods, supports, and all necessary materials and inter-connections to provide a complete system.

.3 Provide 1/0 green insulated copper ground conductor from DBPS ground bus to ground bus in surge tower electrical room.

.4 Run all above ground grounding conductors in conduit.

2. PRODUCTS

.1 Cables 3/0 and smaller to be connected to ground bars via Burndy Quiklug Type QA-2B connectors. Braze connections for cables larger than 3/0.

.2 All ground wires: stranded copper TWH complete with a green jacket, except in transformer yard where bare copper horizontal wire shall be used, unless otherwise shown.

.3 Ground rods: 20 x 10000 mm copper clad steel.

.4 Cable to pipe connectors: made with Burndy GAR connectors.

.5 Provide a copper ground bar complete with lugs suitable to terminate all ground cables.

3. EXECUTION

3.1 Grounding - General

.1 Ground all frames and metallic enclosures of all electrical equipment and electrically operated equipment through the conduit system via a ground wire.

.2 Ground all transformers, switchgear, panelboards and splitters fed from the main distribution centre by grounding conductors sized in accordance with the Canadian Electrical Code. Terminate the ground wire at each end with an appropriate grounding lug and connect to the equipment ground bus. Ground wire to be green TWH.

.3 Ground all sub panels such as lighting panels, local distribution panels, etc. with a green ground wire run back to the panel from which it is fed. Size the ground conductor according to the Canadian Electrical Code.

.4 Ensure all main distribution centres, switchgear, and all panels requiring equipment grounds contain a ground bus of adequate size, and tapped for lugs for the ground wire required.

.5 Ensure all bolted connections are accessible.

.6 Ground all motors by means of an adequately sized green ground wire contained within the feeder conduit.

.7 Include a separate green ground wire in all power conduits including branch circuit wiring sized to Table 16, Canadian Electrical Code.

.8 Bond expansion joints and telescoping sections of raceways using jumper cables as per Canadian Electrical Code.

.9 Use Burndy compression connectors for all grounding splices and terminations unless otherwise shown on the Drawings. For bolted ground connections use Burndy Engineering Company's "Durium".

.10 Connect all transformer neutrals to the main ground bus using bolted connections.

.11 Install rigid conduit sleeves where ground wires pass through concrete slabs.

.12 Provide conduit installed buried in earth or installed in or under grade floor slabs with separate ground wire installed, whether the conduits are metal or not.

.13 Ground all utility services to the electrical system ground.

.14 Ground all metal fences and gates

.15 Selected ground rods shall be accessible with ground wells as shown on Drawings

END OF SECTION

FASTENINGS AND SUPPORTS

1. GENERAL

1.1 Work Included

.1 Supply and install all hangers, supports and inserts for the installation shown on the Drawings and specified herein, as necessary to fasten electrical equipment securely to the building structure.

2. PRODUCT

2.1 Framing and Support System

.1 Materials:

.1 Intermediate duty supporting structures: Aluminum strut channel together with the Manufacturer's connecting components and fasteners for a complete system.

.2 Heavy duty supporting structures: fabricated from welded steel structural members and hot dipped galvanized before installation.

.3 Nuts, bolts, machine screws: stainless steel.

2.2 Concrete and Masonry Anchors

.1 Materials: Hardened steel inserts, zinc plated for corrosion resistance. Epoxy adhesive type.

.2 Components: non-drilling anchors for use in predrilled holes, sized to safely support the applied load with a minimum safety factor of 4.

.3 Manufacturer: Hilti (Canada) Limited.

2.3 Non-Metallic Anchors

.1 Material: Plastic anchors for sheet metal screws.

.2 Manufacturer: Fischer.

2.4 Conduit Supports

.1 General: Malleable iron one-hole conduit straps where exposed to weather. Stamped steel two-hole straps indoors.

.2 Structural Steel: Crouse-Hinds "Wedgetite" supports or equivalent manufactured by Appleton.

.3 Masonry, concrete, stone, etc.: Anchors.

.4 Title: Toggle bolts.

.5 Metal studs, ceiling hangers, etc.: "Caddy-Clips".

.6 Unistrut: Unistrut conduit clamps.

2.5 Cable Supports and Clamps

.1 General: As per conduit supports, except that for single conductor cables, use suitable non-ferrous, or approved stainless steel or aluminum clamps.

3. EXECUTION

3.1 General

.1 Do not cut or drill beams, joists or structural steel unless written permission of the Contract Administrator is obtained.

.2 Distance between conduit or cable supports not to exceed code requirements.

.3 Supports to be suitable for the real loads imposed by equipment.

.4 Supports to be securely fastened, free from vibration and excessive deflection or rotation. Maximum deflections are 4 mm over a 1 m span and 8 mm over a 2 m span.

.5 Install fastenings and supports as required for each type of equipment cables and conduits, and in accordance with Manufacturer's installation recommendations.

.6 Provide conduit rack with 25% spare capacity for multiple runs.

.7 Provide channel support with fittings for vertical runs of conduit and cables.

3.2 Installation

.1 Secure equipment to tile and plaster surfaces with lead anchors.

.2 Secure equipment to poured concrete and concrete masonry with adhesive anchors.

.3 Secure equipment to hollow masonry walls or suspended ceilings with toggle bolts.

.4 Support equipment, conduit or cables using clips, spring loaded bolts, cable clamps designed as accessories to basic channel members.

.5 Fasten exposed conduit or cables to building construction or support system using straps.

.1 One-hole malleable iron or steel straps to secure surface conduits and cables 50 mm and smaller.

.2 Two-hole steel straps for conduits and cables larger than 50 mm.

.3 Beam clamps to secure conduit to exposed steel work.

.6 Suspended support systems:

.1 Support individual cable or conduit runs with 6 mm diameter threaded rods and spring clips.

.2 Support two or more cables or conduits on channels supported by 6 mm diameter threaded rod hangers where direct fastening to building construction is impractical.

.7 Use plastic anchors for light loads only. Use metal anchors for all other loads.

.8 Shot driven pins may only be used with written approval of the Contract Administrator.

.9 Use round or pan head screws for fastening straps, boxes, etc.

.10 Do not support heavy loads from the bottom chord of open web steel joists.

.11 Support outlet boxes, junction boxes, panel tubs, etc., independent of conduits running to them. Support conduits within 600 mm of outlet boxes. Support surface mounted panel tubs with a minimum of four 6 mm fasteners.

.12 For surface mounting of two or more conduits use channels at 1.5 m oc spacing.

.13 Provide metal brackets, frames, hangers, clamps and related types of support structures where indicated or as required to support conduit and cable runs.

.14 Ensure adequate support for raceways and cables dropped vertically to equipment where there is no wall support.

.15 Do not use wire lashing or perforated strap to support or secure raceways or cables.

.16 Do not use supports or equipment installed for other trades for conduit or cable support except with permission of other trade and approval of the Contract Administrator.

END OF SECTION

DISTRIBUTION PANELBOARDS

1. GENERAL

1.1 Description

.1 Provide panelboards for 347/600 V and 120/208 V branch circuit distribution as indicated on schedules shown on the Drawings, complete with all items listed.

.2 Construct panelboards to CSA Standards, apply CSA approval labels.

.3 Panelboards to be manufactured by Eaton Cutler Hammer, Schneider or Siemens.

.4 To be read in conjunction with Section 16471 – Panelboards.

1.2 Shop Drawings and Product Data

.1 Submit Shop Drawings on all panelboards, switchboards and CDPs in accordance with Section 01300 – Submittals.

.2 Drawings to include electrical details of panel, branch breaker types and ratings, bussing type and rating and enclosure type and dimensions

2. PRODUCTS

2.1 Materials

.1 Tub: CSA code gauge galvanized steel, reversible top and bottom, finish painted ANSI 61 grey enamel or as specified in Section 16010 – Electrical General Requirements.

.2 Mains: Copper, ampere ratings as shown, solderless lug connectors sized for cables in panels without main breakers, bolt-on connectors for all main breakers and branch circuit breakers.

.3 Neutral Bars: Same ampere ratings as mains, solderless lugs for connections.

.4 Front shields to cover breaker assembly and neutral bars, leaving wiring gutters accessible when fronts removed.

.5 Front Covers, Doors: CSA code gauge galvanized steel, with doors, concealed hinges, combination locks and latches, interior plastic covered circuit directory cardholders, concealed mounting screws, finish painted, same size as tubs where surface mounted, overlapping trim with wall gaskets where flush mounted.

.6 Locks, Keys: All locks to be keyed alike.

.7 Branch Circuit Breakers: Thermal magnetic with "ON", "OFF" and "TRIPPED" positions, single, two, and three pole as shown; ampere ratings as shown; bolt-on line connections, solderless lug load connections; common trip for two and three pole; rated 240 V 10,000 A

symmetrical short circuit interrupting capacity in 120/208 V panelboards; rated 600 V, 22,000 A, symmetrical short circuit interrupting capacity in 347/600 V panelboards, unless otherwise indicated.

.8 Spaces: Stamp out spaces, install removable fillers where breaker spaces are shown.

.9 Ground Fault Circuit Interrupters: Install breakers having both 5 ma ground fault sensitivity and over current protection, of the amperage rating indicated, in the panelboards, where required. Wire each ground fault breaker with a separate neutral conductor wired through the interrupter to the ground bus.

3. EXECUTION

3.1 Mounting

.1 Mount panel boards inside of main power distribution cabinet.

3.2 Wiring

.1 Install branch circuit wiring in neat bundles at sides of wiring gutters, with wires to branch breakers horizontal.

3.3 Identification

.1 Provide lamacoid plate securely and permanently attached to the exterior of each panelboard door showing panelboard designation, voltage, and source of feed.

.2 For all ground fault breakers, provide a sign indicating that circuits are so protected and that equipment should be tested regularly.

3.4 Branch Circuit Directory

.1 Provide typed directory identifying all branch circuits. Directory to indicate device and location.

3.5 Locking Straps

.1 Locking Straps: To permit automatic tripping of breakers but prevent manual switching, for exit lights, receptacles feeding emergency battery packs, fire alarm panels and where designated.

3.6 Keys

.1 Provide three (3) keys.

END OF SECTION

DISCONNECT SWITCHES - FUSED AND NON-FUSED UP TO 600 V - PRIMARY

1. GENERAL

1.1 Description

.1 Provide disconnect switches for 347/600 V and 120/208 V distribution as indicated on the Drawings, as manufactured by Eaton Cutler Hammer, or Schnieder.

1.2 Shop Drawings

.1 Submit Shop Drawings in accordance with Section 01300 – Submittals.

.2 Provide data for various sizes and types to be used

2. PRODUCTS

2.1 Disconnect Switches

.1 Ratings: 600 V for 347/600 V distribution, 240 V for 120/208 V distribution. Unless otherwise shown, 3 pole for 3 phase, 3 wire distribution, 3 pole and solid neutral for 3 phase 4 wire distribution. Ampere ratings as shown on the Drawings or to suit load requirements. For motors, use disconnect switches with HP ratings at least equal to motor HP.

.2 Enclosures: CSA code gauge galvanized steel, hinged doors, external operating handles. For disconnect switches in dry locations, use EEMAC-1 and EEMAC-4x in wet location or stainless steel EEMAC 4 where exposed to weather. Provide ON-OFF switch position indication on switch enclosure cover.

.3 Finish: One (1) primer coat and one (1) finish coat on all metal surfaces, colours as per Section 16010 – Electrical General Requirements.

.4 Switch mechanisms: Quick make and quick break action with self wiping contacts, solderless pressure lug connectors. For switches 100 A and over, provide non-tracking arc shrouds. All switch poles to operate together from a common operating bar. Provide for padlocking disconnect switches in "OFF" position. Doors to be interlocked and complete with defeat mechanism, to prevent opening when handle in “ON” position.

.5 Neutral Bars: Where distribution system has grounded neutral conductor, provide neutral bar where required with ampere rating equal to switch rating, in enclosure. Provide ground bar for terminating ground conductors.

.6 Fuse Holders: Provide fuse holders (relocatable and suitable without adapters) on load side of switches, ampere rating equal to switch ratings, suitable for fuses specified.

2.2 Fuses

.1 All fuses to be 100,000 A (minimum) interrupting capacity of the current limited type. In addition, fuses feeding motors to be of the time delay type.

2.3 Spare Parts

.1 Provide one (1) full set of spare fuses, three for each different ampere rating used, stored in suitable enclosure.

3. EXECUTION

3.1 Disconnect Switches

.1 Mounting: Provide supports independent of conduits. Wall mount where possible, otherwise provide Unistrut frame support. Where switches are grouped, mount in uniform arrangement.

.2 Wiring: Connect line and load cable to all switches.

.3 Fuse Rating: Install so that rating is visible.

.4 Identification: Provide lamacoid plate in accordance with Section 16010 – Electrical General Requirements, on each switch showing voltage, source of supply and load being fed.

.5 Example:

.1 Mixer MX-05A-161

.2 600 V

.3 Fed from MC-06A-901

END OF SECTION

DRY TYPE TRANSFORMERS UP TO 600 V PRIMARY

1. GENERAL

.1 Provide enclosed dry type transformers 600 V primary to 120/208 V.

.2 Product Data - 3 phase, 4 wire secondary

.1 Submit product data in accordance with Section 16010 – Electrical General Requirements.

.3 Transformers to conform to CSA C57.12 and L2 standards, and are to be approved to CSA Code Part 2, Standard C22.2, No. 47 and CSA C9.

2. PRODUCTS

2.1 Transformers

.1 General: Dry type, air cooled, self ventilated. Enclosures to be EEMAC-1 type, code gauge steel, complete with ventilating openings, access panels, mounting brackets, and solderless primary and secondary cable connectors. Enclosures to have zinc chromate prime coat and enamel finish coat per Section 16010 – Electrical General Requirements. Transformers to be single or three phase as noted on the Drawings. Dry type transformers shall be Square D, FPE, Cutler-Hammer or approved equal.

.2 Design

.1 Type: ANN

.2 3 phase, 600 V input, 120/208 V output, 60 Hz.

.3 Voltage primary taps: 2.5% Full capacity above and below normal

.4 Insulation: Class 220

.5 Basic Impulse Level (BIL): 10 kV B.I.L

.6 Hipot: 4 kV

.7 Average Sound Level: 45 dB

.8 Impedance at 170°C: 6.0% max.

.9 Enclosure: EEMAC 1, removable metal front panel

.10 Mounting: suitable for wall mounting

.11 Finish: In accordance with Section 16010 – Electrical General Requirements

.12 Max. Winding Temperature: 150°C rise with temperature continuous full load

.13 Max. Lead Connection: 55°C rise with temperature continuous full load

.14 Copper windings

2.2 Equipment Identification

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

.2 Label Size: 7

3. EXECUTION

3.1 Installation

.1 Mount dry type transformer on wall.

.2 Ensure adequate clearance around transformer for ventilation.

.3 Install transformers in level upright position.

.4 Remove shipping supports only after transformer is installed and just before putting into service.

.5 Loosen isolation pad bolts until no compression is visible.

.6 Make primary and secondary connections in accordance with wiring diagram.

.7 Record secondary voltage when transformers are carrying approximately 75% of full load. Adjust tap connections to give a continuous secondary voltage of 120 V phase to neutral. Set tap connections for above 120 V rather than below.

.8 Connections to transformers shall be in flexible conduit and shall enter the enclosure below the coils.

.9 Before energization, keep transformers or storage room enclosures above 10°C ambient.

END OF SECTION

PANELBOARDS - BREAKER TYPE

1. GENERAL

1.1 Shop Drawings

.1 Submit Shop Drawings in accordance with Section 01300 – Submittals.

.2 Drawings to include electrical detail of panel, branch breaker type, quantity and ratings, and enclosure type and dimensions.

2. PRODUCTS

2.1 Panelboards

.1 Panelboards: product of one (1) Manufacturer.

.1 Install circuit breakers in panelboards before shipment.

.2 In addition to CSA requirements manufacturer's nameplate must show fault current that panel including breakers has been built to withstand.

.2 208 or 600 V panelboards: bus and breakers rated for symmetrical interrupting capacity or as indicated.

.3 Sequence phase bussing with odd numbered breakers on left and even on right, with each breaker identified by permanent number identification as to circuit number and phase.

.4 Panelboards: mains, number of circuits, and number and size of branch circuit breakers as indicated.

.5 Two (2) keys for each panelboard and key panelboards alike.

.6 Copper bus with neutral of same ampere rating as mains.

.7 Mains: suitable for bolt-on breakers.

.8 Trim with concealed front bolts and hinges.

.9 Trim and door finish: baked grey enamel.

2.2 Breakers

.1 Breakers: to Section 16477 – Moulded Case Circuit Breakers.

.2 Breakers with thermal and magnetic tripping in panelboards except as indicated otherwise.

.3 Main breaker: separately mounted on top or bottom of panel to suit cable entry. When mounted vertically, down position should open breaker.

.1 Lock-on devices for breakers as indicated.

2.3 Equipment Identification

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

.2 Nameplate for each panelboard size 4 engraved as indicated.

.3 Nameplate for each circuit in distribution panelboards size 2 engraved as indicated.

.4 Complete circuit directory with typewritten legend showing location and load of each circuit.

3. EXECUTION

3.1 Installation

.1 Locate panelboards as indicated and mount securely, plumb, true and square, to adjoining surfaces.

.2 Install surface mounted panelboards on plywood backboards. Where practical, group panelboards on common backboard.

.3 Mount panelboards to height specified in Section 16010 – Electrical General Requirements or as indicated.

.4 Connect loads to circuits.

.5 Connect neutral conductors to common neutral bus with respective neutral identified.

END OF SECTION

MOULDED CASE CIRCUIT BREAKERS

1. GENERAL

1.1 Product Data

.1 Submit product data in accordance with Section 01300 – Submittals.

.2 Include time-current characteristic curves for breakers with interrupting capacity of 22,000 A symmetrical (rms) and over at system voltage.

2. PRODUCTS

2.1 Breakers General

.1 Bolt-On Moulded Case Circuit Breaker: Quick-make, quick-break type, for manual and automatic operation with temperature compensation for 40°C ambient.

.2 Common-Trip Breakers: With single handle for multi-pole applications.

.3 Magnetic instantaneous trip elements in circuit breakers to operate only when value of current reaches setting. Trip settings on breakers with adjustable trips to range from 3 to 8 times current rating.

.4 Provide circuit breakers with interchangeable trips as indicated.

.5 For breakers 400 A and larger, provide with solid state LSIG electronic trips.

2.2 Thermal Magnetic Breakers

.1 Moulded case circuit breaker to operate automatically by means of thermal and magnetic tripping devices to provide inverse time current tripping and instantaneous tripping for short circuit protection.

2.3 Magnetic Breakers

.1 Moulded case circuit breaker to operate automatically by means of magnetic tripping devices to provide instantaneous tripping for short circuit protection

2.4 Solid State Trip Breakers

.1 Moulded case circuit breaker to operate by means of a solid-state trip unit with associated current monitors and self-powered shunt trip to provide inverse time current trip under overload condition, and long time, short time, instantaneous tripping for phase and ground fault short circuit protection.

2.5 Optional Features

.1 Include where indicated on Drawings:

.1 Shunt trip

.2 Auxiliary switch

.3 Motor-operated mechanism

.4 Under-voltage release

.5 On-off locking device

.6 Handle mechanism

.7 Keyed interlocks

.8 Non-auto

.9 Solid state trip units.

3. EXECUTION

3.1 Installation

.1 Install circuit breakers as indicated.

.2 Identification: In accordance with Section 16010 – Electrical General Requirements, provide lamicoid plate on each breaker showing voltage and load being fed. Example - Transformer TX-05A-902.

END OF SECTION

POWER SURGE PROTECTORS

1. GENERAL

1.1 Related Work

.1 Section 16010 – General Electrical Requirements.

.2 Section 16471 – Panelboards - Breaker Type.

1.2 System Description

.1 A transient voltage surge suppressor for the protection of downstream electronic equipment connected to the building power supply. Provide a unit compatible with non-linear loads, providing effective high-energy transient voltage suppression, surge current diversion and high-frequency electrical noise filtering while connected in parallel with a facility's distribution system. Utilize non-linear voltage dependent metal oxide varistors or selenium cells. For the suppression system's components, do not utilize gas tubes, spark gaps, or silicon avalanche diodes. Refer to the device as a TVSS filter for the purpose of this Specification and Drawings.

1.3 Shop Drawings and Product Data

.1 Submit Shop Drawings in accordance with Section 01300 – Submittals.

.2 Provide mounting details, dimensions, wiring diagrams and ratings for each type.

2. PRODUCT

2.1 Operation and Environment

.1 Voltage: Use TVSS devices suitable for the voltage and systems configuration as indicated on the single line diagram(s).

.2 MCOV: Ensure the MCOV of the suppressor is greater than 125% for 120/208 V systems and 115% for 347/600 V systems.

.3 Protection Modes: Provide transient voltage surge suppression paths for all possible common and normal modes (between each line and ground, neutral and ground, line to line and each line and neutral). Ensure the primary suppression path is not to ground.

2.2 Suppression Component

Peak surge Current per Phase	240,000 A	(Main entrance panel applications)
	120,000 A	(Branch Panel Applications)
	30,000 A	(Plug-in / Cord -- connected individual equipment protection)
Let Through Voltage (L-N)	120 V (individual equipment units)	330 V
	208 V Units	500 V
	600 V Units	1200 V
TVSS clamping components response time	< 1 nanosecond	

2.3 Filtering

.1 TVSS: contain a high frequency extended range tracking filter.

.2 Noise attenuation ≥45 dB @ 1`00 kHz.

.3 Main entrance panel application effective filtering bandwidth - 180 Hz to 50 Mhz. Branch panel application effective filtering bandwidth - 1 kHz to 50 Mhz. Plug-in/Cord - Connected Individual Equipment application effective filtering bandwidth - 100 kHz to 100 Mhz.

2.4 Panelboard Component (Integrated TVSS Panel)

.1 Main Bus: copper, tin plated main bus.

.2 Circuit Breakers: over center toggle mechanism type which use bolt-on connectors to line side panelboard connectors.

.3 Panelboard Enclosure: Provide the panelboard in an EEMAC 1 enclosure. Configure the TVSS/filter status indicators to be visible without the need to open the panelboard door. Provide a lockable door to limit access to authorized personnel only. Make trim assembly tamper proof. Finish the trim (doors) in grey ASA61 paint.

.4 Neutral Bus: Equip with a copper 100% rated neutral bus, including a sufficient quantity at solderless type lugs to service the total unit circuit capacity.

.5 Wiring Gutters: Equip the integrated TVSS filtering panel with a complete perimeter wiring gutter with a cross-sectional dimensions of not less that 12,200 mm^2.

.6 Safety and Insulated/Isolated Ground Bus: Provide the integrated filter panel with a safety and insulated/isolated ground bus equipped with solderless type lugs of quantity to sufficiently service the circuit loads.

2.5 Individual Equipment Protection - Plug In

.1 Incorporate an appropriately rated ULC listed thermal-magnetic molded case main circuit breaker.

.2 Input Cord/Plug: Equip with an appropriately rated 1800 mm power cord and NEMA twist-lock or straight blade plug as required.

.3 Output Receptacles: Equip with two NEMA 5-15R duplex receptacles. Equip with up to six (6) appropriately rated NEMA twist-lock or straight blade receptacles as specified. Provide a unit with the capacity to accommodate large modern transfer plugs.

.4 Enclosure: Provide in a NEMA 1 type enclosure, painted inside and out.

2.6 General Features

.1 Factory install the integrated TVSS panel and connect to the bus bar.

.2 Connectors: Provide terminals for all the necessary input and output power and ground connections on the TVSS.

.3 Enclosure: Provide the specified system in a heavy duty NEMA 12 dust tight enclosure with no ventilation openings for maintenance and branch panel applications. Ensure indication of surge current module status is visible without opening the door.

.4 Internal Connections: Make all surge current diversion connections by way of low impedance wiring. Wire surge current diversion components for reliable low impedance connections. Do not use plug-in component modules, quick disconnect terminals or printed circuit boards in surge suppression paths.

.5 Unit Status Indicators: Provide red status indicators on the hinged front cover to indicate unit phase status. Take the absence of the red light to reliably indicate that one or more surge current diversion phases have failed and that service is needed to restore full operation.

.6 Fuses: Utilize internal fuses rated with a minimum interrupting capability of 2000,000 A or greater.

.7 Identification: Include Manufacturer’s nameplate, ULC rating, and a CSA approval on the exterior enclosure.

.8 Testing: Include assurance checks, “Hi-Pot” test at 2 times rated voltage plus 1000 V per ULC requirements, and operation and calibration tests.

2.7 Approved Manufacturers

.1 Current Technologies

.1	Main panel application	Model MP
.2	Branch panel application	Model DPA
.3	Integrated TVSS panel	Model EGP
.4	Individual Equipment Protection	

.2 Liebert Corporation

.1	Main panel applications	Model LCG-C3
.2	B ranch panel applications	Model LCG-C2
.3	Integrated TVSS panel	Model LPG

.3 Tycor International Corporation

.1	Main panel applications	Model PTY-HE
.2	Branch panel applications	Model PTY-SA
.3	Individual Equipment Protection	

.4 Schnieder/ Square D Model IMA

.5 Siemens Model TPS-6

3. EXECUTION

3.1 Installation

.1 Install with Manufacturer's recommended conductors tapped from the electrical service switchboard conductor system. Conductors are to be as short and straight as possible. Twist input conductors to the TVSS together to reduce impedance during high frequency filtering.

.2 Install an appropriately sized manual safety disconnect before and in line with the TVSS from the electrical service for the purpose of electrically isolating the device from the system should service be required without interrupting the main service. Coordinate required disconnect ampacity with TVSS Manufacturer.

.3 The TVSS should follow the manufacturer's recommended practices as outlined in the Manufacturer's installation and Maintenance Manual and in compliance with all applicable electrical codes.

.4 Install individual equipment protection devices at the same voltage rating as the intended protected equipment and as close as possible to the intended protected equipment.

3.2 Extended Warranty

.1 Warranty: Manufacturer to provide a five (5) year warranty on the TVSS filter, a two (2) year warranty on the panelboard and circuit breakers, and a two (2) year warranty on individual equipment plug-in units, all commencing upon Total Performance.

END OF SECTION

GENERAL PROVISIONS FOR INTERIOR LIGHTING

1. GENERAL

1.1 Work Included

.1 Supply and install lighting fixtures complete with lamps, ballasts and all necessary fittings.

1.2 Code Requirements

.1 Installation of lighting equipment to conform to Section 30, Canadian Electric Code, Part 1, and as amended or supplemented by provincial, municipal or other regulatory agencies having jurisdiction.

1.3 Shop Drawings

.1 Submit Shop Drawings in accordance with Section 01300 – Submittals.

.2 Submit a complete list of the types of lighting fixtures, lamps, ballasts and accessories with catalogue illustrations, data sheets, etc. for review. Bind in a suitable booklet and keep one (1) copy of this booklet at the Site at all times.

.3 Submit complete photometric data, based on actual fixtures proposed for project. Substantiate brightness and efficiency requirements. Photometric data must be produced by a recognized independent laboratory.

1.4 Manufacturer's Operational Test

.1 Test fixtures with rated lamps for starting and operation.

.2 Check wiring for agreement with design circuit.

.3 Test for short circuits and improper grounds.

.4 Test operation of fixture and lamp with ballast.

1.5 Plant Inspection

.1 A preliminary inspection of lighting fixtures and their components may be made at manufacturer's factory. Inform Contract Administrator of progress and various stages of manufacturing and arrange an appropriate time for inspection.

1.6 Lamps Used for Temporary Lighting

.1 Fluorescent or mercury lamps may be used for temporary light and lamps used for this purpose prior to Substantial Performance. Total Performance relamp faulty or burned out lamps prior to Substantial Performance at the Contractor’s cost.

.2 Metal halide, sodium, incandescent and quartz lamps are not to be used for temporary lighting, unless all lamps so used are replaced with new lamps immediately prior to completion at no additional cost to the City.

2. PRODUCTS

.1 Provide, wherever possible, commercially available stock lighting fixtures meeting specified requirements and as shown on the Drawings.

.2 Different fixtures may be supplied by different Manufacturers. Similar fixtures to be supplied by the same Manufacturer.

.3 Provide only lighting fixtures which are structurally well designed and constructed and which use new parts and materials of highest commercial grade available. Unless otherwise specifically noted, fixtures to be of the quality stated in the Manufacturer's catalogues and data sheets.

.4 Refer to related sections for details of fixtures and accessories.

.5 Use self-aligning ball joint hangers for rod suspended fixtures.

.6 Use cadmium plated chains for suspended fixtures in unfinished areas.

.7 Refer to Luminaire schedule on drawings for luminaire descriptions and acceptable Manufacturers.

3. EXECUTION

3.1 Installation

.1 Install fixtures in accordance with the Manufacturer's requirements, code requirements, and as shown on the Drawings.

.2 Confirm compatibility and interface of other materials with luminaire.. Report discrepancies and defer ordering until clarified.

.3 Supply plaster frames, trim rings and backboxes to other Divisions as the Work requires.

.4 Ground lighting equipment to metal raceway, armour of armoured cable, grounding conductor in non-metallic sheathed cable, or to a separate grounding conductor.

.5 Co-ordinate with contractors responsible for the Work of other Divisions to avoid conflicts between luminaires, supports and fittings and process, mechanical and structural equipment.

.6 Provide guards where fixtures are subject to mechanical damage as required by code or shown on the Drawings.

3.2 Workmanship

.1 Completely clean all glassware, lamps, and hangers. Polish metal parts before completion.

.2 Provide suitable extension couplings for row mounted fixtures.

.3 Protect fixtures, hangers, supports, fastenings and accessory fittings at the Site prior to and during installation. Unless fixtures are erected immediately, after delivery to Site, deliver in original cartons or enclosed in air-tight plastic wrapping. Store in a dry and secure space on Site. Protect hangers, supports, fastenings and accessory fittings against corrosion. Take care during installation to ensure that insulation and corrosion protection is not damaged.

.4 Fixtures which show evidence of corrosion, rough handling, scratching of finishes, etc. are to be replaced with new fixtures at no additional cost to the City.

.5 Install recessed fixtures to permit removal from below, for access to outlet or prewired fixture box.

.6 Hang and mount fixtures to prevent distorting fixture frame, housing, sides or lens frame, and permit correct alignment of several fixtures in a row.

.7 Support fixtures as shown on Drawings, level, plumb and true with structure and other equipment in horizontal or vertical position as intended. Install wall or side bracket mounted fixture housings rigidly and adjust to a neat flush fit with mounting surface.

.8 Adjust length of hangers of suspended fixtures to hang fixture bodies level and in same horizontal plane, unless shown otherwise on Drawings.

.9 Install ceiling canopies to cover suspension attachments and fit tightly to ceiling without restricting alignment of hanger.

.10 For recessed fluorescent fixtures mounted in suspended ceiling with exposed tee bar grid system, support by the ceiling tee bar grid structure. Provide any additional support necessary for oversize fixtures, or to meet code requirements.

.11 For metal inserts, expansion bolts or toggle bolts accurately locate in relation to outlet boxes, for perfect alignment and spacing of suspension stems or other hangers.

.12 For remote mounted ballasts, supply mounting board and space ballasts in accordance with Manufacturer's directions. Size wiring from ballasts to remote fixtures to meet Manufacturer's requirements.

.13 Remove any noisy ballasts from the fixtures and replace at no additional cost to the City prior to completion.

END OF SECTION

LIGHTNING PROTECTION

1. GENERAL

1.1 References

.1 ANSI/IEEE 837, Qualifying Permanent Connections Used In Substation Grounding

.2 CAN/CSA-B72, Installation Code for Lightning Protection Systems

.3 Canadian Electrical Code Part 1 C.22-1, all relevant sections

1.2 Description of System

.1 System shall conform to Class III as defined in CSA-B72. System to consist of metallic air terminals, lightning conductors connecting air terminals to ground, ground rods, connections to water pipes.

.2 Bond roof hatch, steel flashing, and steel siding as required by CSA-B72.

1.3 Shop Drawings

.1 Submit Shop Drawings in accordance with Section 1330 - Submittals.

.2 Indicate materials and methods of attachment of conductors to air terminals to satisfy the requirements noted herein and as shown on the Record Drawings.

2. PRODUCTS

2.1 Materials

.1 All materials to be approved by the local authority for Class III structures.

.2 A minimum #2/0 gauge, tinned copper stranded conductor or as per local authority.

.3 Fastenings and attachment straps: As per Manufacturer’s recommendation and/or local authority and as shown on the Drawings.

.4 Air Terminals shall be solid copper with cast bronze base, 1200 mm long complete with galvanized steel tripod base.

.5 Ground rods shall be 19 mm x 6000 mm copper clad steel.

.6 Bonding devices and miscellaneous connectors on the roof shall be cast bronze with bolt pressure connections.

.7 All connections to building structural steel, re-enforcing steel, ground rods and buried connections shall be CADWELD (exothermic).

3. EXECUTION

3.1 General

.1 Provide a complete installation in conformance with the Record Drawings and Technical Requirements and the applicable codes and standards.

3.2 Spacing or Bonding Electrical and Lightning Rod Systems

.1 Where practicable, a clearance of at least 2 m shall be provided between lightning rod conductors and electrical conductors and equipment.

.2 Install lightning protection in accordance with CAN/CSA – B72.

.3 Submit certificate of installation to the Contract Administrator.

3.3 Inspection

.1 Obtain inspection certificate from a Code Consultant for discharge conductor passing through any fire separating membrane.

.2 Provide resistance measurements of all leads exiting to ground.

.3 Verify continuity of entire system as part of overall system certification. Verify connections to the below grade ground system and ensure adequate supply of ground connections. Notify Contract Administrator where any anomalies may exist with respect to the below grade grounds respecting connections, continuity and ground resistance.

END OF SECTION

UNIT HEATERS

1. GENERAL (NOT USED)

2. PRODUCT DATA

.1 Submit product data in accordance with Section 01300 – Submittals.

.2 Product data to include:

.1 Mounting methods

.2 Physical size

.3 Layout and diagrams of unit heaters

.4 kW rating, voltage, phase

.5 Cabinet material thicknesses

.6 Finish.

2.2 Operation and Maintenance Data

.1 Provide O&M data for unit heaters for incorporation into manual specified in Section 01730 – Operation and Maintenance Manuals.

3. PRODUCTS

3.1 Unit Heaters

.1 Unit heater: Corrosion resistant horizontal discharge complete with adjustable louvers finished to match cabinet.

.2 Fan type unit heaters with built-in high-heat limit protection.

.3 Fan motor: totally enclosed, permanently lubricated ball bearing type with resilient mount. Built-in fan motor thermal overload protection.

.4 Hangers for wall mounting.

.5 Elements: stainless steel fintube.

.6 Cabinet: stainless steel with brackets for wall mounting.

3.2 Controls

.1 Built in thermostat and support controls.

3.3 Acceptable Manufacturers

.1 Chromolox HVH Series, size and voltage as indicated on Drawings, or approved equal.

4. EXECUTION

4.1 Installation

.1 Mount on wall as indicated.

.2 Supply and install disconnect switch for unit heater.

.3 Make power and control connections.

4.2 Field Quality Control

.1 Test cut-out protection when air movement is obstructed.

.2 Test fan delay switch to assure dissipation of heat after element shut down.

.3 Test unit cut-off when fan motor overload protection has operated.

.4 Ensure that heaters and controls operate correctly.

END OF SECTION

STRIP HEATERS

1. GENERAL

1.1 Description

.1 Process strip heaters to provide ice and frost melting on air relief vent grating.

1.2 Product Data

.1 Submit product data in accordance with Section 01300 – Submittals.

.2 Product data to include:

.1 Mounting methods

.2 Physical size

.3 Layout and diagrams of unit heaters

.4 kW rating, voltage, phase

.5 Cabinet material thicknesses

.6 Finish.

1.3 Operation and Maintenance Data

.1 Provide operation and maintenance data for strip heaters for incorporation into manual specified in Section 01730 – Operation and Maintenance Manuals.

2. PRODUCTS

2.1 Strip Heaters

.1 Strip heater: Explosion proof, solid aluminum body.

.2 Built-in high-heat limit protection.

.3 Body extrusion to have channel for mounting to surface. Clamps shall be included.

.4 Elements: stainless steel fintube.

.5 Cabinet: stainless steel with brackets for wall mounting.

.6 220 Watts, 120VAC

.7 610 mm long extrusion.

2.2 Controls

.1 Wall mounted line voltage thermostat and disconnect switch.

.2 Thermostat: NEMA 4X, -18°C to +50°C, 120VAC 25Amp contact rating.

2.3 Acceptable Manufacturers

.1 Strip heater: Chromalox AEPS-024-220-917.

.2 Thermostat: Chromalox AR4X-1C

3. EXECUTION

3.1 Installation

.1 Mount strip heater on under side of air relief vent grating. Ensure solid contact with grating to provide good heat transfer.

.2 Supply and install conduit sleeve cast in floor for power connection from strip heater to disconnect switch. Connect using Teck cable. Cable and heater shall be installed to allow for opening of vent grating without removal of the heater.

.3 Supply and install disconnect switch and thermostat for strip heater. Mount at 1700 mm.

.4 Make power and control connections.

3.2 Field Quality Control

.1 Ensure that heaters and controls operate correctly.

END OF SECTION

CONNECTIONS TO MECHANICAL EQUIPMENT

1. GENERAL

1.1 Related Work

.1 Mechanical: Division 15

1.2 Requirements

.1 Provide a complete system of wiring to motors and controls as specified herein and as shown on the Drawings.

.2 Unless specifically noted otherwise, wire and leave in operation all electrically operated equipment supplied under this contract related to this Project. Examine the Drawings and Shop Drawings of all Divisions for the extent of electrically operated equipment supplied under other contracts.

.3 All control wiring diagrams shown on the Drawings illustrate typical control circuits applicable to the equipment. Control circuits may vary with different Manufacturers of equipment. Verify all control circuits with the Manufacture's of the equipment and make any corrections that may be required.

.4 Unless specifically noted otherwise, supply all pushbuttons, relays, starters, etc., necessary for the operation of equipment. Check all starters, relay coils and thermal elements to ensure that they provide the necessary protection for motors.

.5 Do not operate motors and controls until approval is obtained from the trade providing equipment.

.6 Examine Drawings and Shop Drawings of other Divisions to obtain exact location of motors and equipment shown on Drawings. Where necessary, obtain conduit locations from other trades' Drawings and Shop Drawings.

.7 Assist in placing in operation all mechanical equipment having electrical connections.

.8 Provide all power wiring for all motors and control wiring as indicated on the Drawings.

2. PRODUCTS

2.1 3 Phase Motor Disconnect Switches

.1 Industrial Type "A", having quick make, quick break visible blade mechanism, cover interlocks and padlocking switch in the closed or open position. Use EEMAC 4 enclosures outdoors, and EEMAC 1 indoors switches to be HP rated, heavy duty type.

2.2 120 V, 1 Phase Disconnect Switches

.1 Manual starter without overload relay. Use weather proof in Category 1 locations

2.3 208 V, 1 Phase Motor Disconnect Switches

.1 Manual starter without overload relay.

3. EXECUTION

3.1 Installation

.1 Supply and install disconnect switches for all unit heaters and strip heaters.

.2 Supply and install all wiring between all force flow, unit heaters, strip heaters and their thermostats.

END OF SECTION

STARTING OF ELECTRICAL EQUIPMENT SYSTEMS

1. GENERAL

1.1 Related Work

.1 Section 16980 – Testing, Adjusting and Balancing of Electrical Equipment and Systems

1.2 Coordination

.1 Coordinates starting of electrical equipment and systems with testing, adjusting and balancing, and demonstration and instruction of:

.1 Electrical equipment and systems specified in Division 16

.2 Mechanical equipment and systems specified in Division 15

.3 Other equipment and systems specified in other Divisions

.2 Where any equipment or system requires testing, adjusting or balancing prior to starting, ensure that such work has been completed prior to starting of electrical equipment and systems.

2. PRODUCTS (NOT USED)

3. EXECUTION

3.1 Energizing Main Electrical System

.1 Prior to energizing main electrical system:

.1 Verify supply voltage and phase rotation.

.2 Close and open all devices to ensure proper mechanical operation.

3.2 Energizing Equipment

.1 Prior to energizing equipment provided under other Sections and equipment provided by the City, confirm equipment nameplate data with characteristics of power supply.

END OF SECTION

TESTING, ADJUSTING AND BALANCING OF ELECTRICAL EQUIPMENT AND SYSTEMS

1. GENERAL

1.1 Intent

.1 Except where otherwise specified, arrange and pay for testing, adjusting, balancing and related requirements specified herein.

.2 If test results do not conform with applicable requirements, repair, replace, adjust or balance equipment and systems. Repeat testing as necessary until acceptable results are achieved.

.3 Provide all labour, materials, instruments and equipment necessary to perform the tests specified.

.4 All tests shall be witnessed by persons designated by the City, who shall also sign the test documentation.

.5 Submit procedures proposed in writing for approval two (2) weeks prior to test.

1.2 Related Work

.1 Section 16010 – Electrical General Requirements.

.2 Section 16960 – Starting of Electrical Systems and Equipment.

1.3 Manufacturer's Production Test Records

.1 If requested, submit copies of production test records for production tests required by EEMAC and CSA standards for manufactured electrical equipment.

1.4 Site Testing Reports

.1 Log and tabulate test results on appropriate test report forms.

.2 Submit forms to Contract Administrator for approval prior to use.

.3 Submit completed test report forms as specified, immediately after tests are performed.

1.5 Reference Documents

.1 Perform tests in accordance with:

.1 The Contract Documents

.2 Requirements of authorities having jurisdiction

.3 Manufacturer's published instructions

.4 Applicable CSA, IEEE, IPCEA, EEMAC, and ASTM standards

.2 If requirements of any of the foregoing conflict, notify Contract Administrator before proceeding with test and obtain clarification.

1.6 Manufacturer's Site Services

.1 Arrange and pay for the site services of approximately qualified Manufacturer's Representatives where Site testing, adjusting, or balancing of electrical equipment or systems' performed by Manufacturer's Representatives is:

.1 Specified, or

.2 Otherwise required to ensure that electrical equipment and systems are operational in full compliance with the Contract Documents

1.7 Sequencing and Scheduling

.1 Except where otherwise specified, perform all testing, adjusting, balancing and related requirements specified herein prior to Interim Acceptance of the Work.

.2 Perform voltage testing and adjusting after user occupancy or utilization of facility.

2. PRODUCTS

2.1 Test Equipment

.1 Provide all equipment and tools necessary to perform testing, adjusting and balancing specified herein and as otherwise required.

3. EXECUTION

3.1 Testing of Wiring and Wiring Devices

.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 cable Manufacturer. Test results shall be properly tabulated, signed, dated and submitted with maintenance manuals.

.2 Test service grounding conductors for ground resistance.

.3 Test all wiring devices for correct operation.

.4 Test all receptacles for proper polarity and circuitry.

3.2 Ground Resistance Testing

.1 Measure ground resistance with earth test meter to verify compliance with CSA C22.2 No. 0.4 and Canadian Electrical Code.

3.3 Load Balance Testing

.1 Perform load tests when as many loads as possible, prior to Interim Acceptance of the Work, are operable.

.2 Turn on all possible loads.

.3 Test load balance on all feeders at distribution centres, MCC and panelboards.

.4 If load balance exceeds 15%, reconnect circuits to balance loads.

3.4 Voltage Testing and Adjusting

.1 Test voltage at all panelboards.

.2 Adjust transformer tap settings to compensate for under-voltage or over-voltage conditions, if directed to do so by Contract Administrator.

END OF SECTION

1. GENERAL

1.1 Requirements of Work

.1 Supply, install, Performance Verify, and provide warranty for a complete and fully documented I&C system as shown on the Drawings and specified herein. The I&C system will form a subsystem of the overall WTP control system and contains Vendor Packages as 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 Instrumentation cabling

.6 Instrumentation power supplies

.7 Conduit and cable tray

.8 PLC based control system

.3 Documentation provided by the Contractor shall include as a minimum:

.1 Equipment descriptive data.

.2 Equipment installation instructions, service manuals, 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, changes, etc.

.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 Records of as-built information for the complete instrumentation system.

.7 For the PLC based control system, the Contractor shall provide detailed documentation of the system hardware.

.4 Documentation provided by the Contractor shall be formatted as follows:

.1 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 I/O Index – A sorted index of the control system I/O points shown on the P&IDs, giving the supporting documentation as per the instrument index.

.4 Instrument Specification Sheets – Detail the relevant data for the supply of devices.

.5 Instrument Loop Diagrams – Show typical interconnections and hook-up of devices. The Contractor is to produce an instrument loop diagram for each device and record all relevant information on each sheet for submission at the completion of the Work. Fill in all terminal and wiring numbers etc. from the Shop Drawings as they become available. A set of 'B' size (11" x 17") AutoCAD drawings and associated files will be made available to the Contractor.

.6 Location Drawings – Indicate in plan and/or elevation views where the instrument elements are physically located. These Drawings are provided to assist the Contractor 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.

.5 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 1 through 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 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	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

.6 Related Work

.1 Mechanical: Division 15

.2 Electrical: Division 16

.7 Codes, Rules, Permits and Fees

.1 Give all required notices, submit Drawings, obtain all permits, licenses, and certificates, and pay all fees required for this Work.

.2 Furnish a certificate of final inspection and approvals from inspection authorities to the Contract Administrator.

.8 Qualifications

.1 The instrumentation Subcontractor shall be a firm normally engaged and fully competent in the type of Work described in this Section of the Specification. The firm

shall have been continuously and successfully engaged in this business for at least five (5) years.

.2 The instrumentation subcontractor shall be experienced in the process and instrument requirements of this Contract.

.3 The instrumentation subcontractor shall show that it maintains a fully equipped and qualified organization, capable of performing the present Work and of providing warranty service to the system after installation.

.4 Qualified journeyman instrument mechanics that are familiar with the devices being installed shall perform all instrument hook-ups, calibrations, and checkouts.

.5 Qualified journeyman electricians shall perform all control wiring installation and connections.

.9 Standards of Workmanship

.1 Arrange and install products to fit properly into designated building spaces.

.2 Install products in accordance with the recommendations and ratings of the product Manufacturers.

.10 Contract Drawings and Specifications

.1 Supply and install all items and accessories specified by the Drawings or the Specification in the quality and quantity required. Perform all operations as designated by the Specifications according to the methods prescribed, complete with all necessary labour and incidentals.

.2 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. Supply and install such specified items or subjects.

.3 Provide all minor items and work not shown or specified but which are reasonably necessary to complete the Work.

.4 The responsibility to determine which Division provides various products and work is specified in Part D. Additional compensation will not be considered because of differences in interpretation of Specifications.

1.2 Equipment

.1 Indicate the type and make of all equipment and materials proposed for this work within forty (40) Business Days of award of Contract.

.2 Receiving, storing, and protection of components during construction:

.1 Examine each component upon delivery to Site. Report all damage noted to the Contract Administrator prior to accepting or rejecting delivery. All instrumentation primary elements, control components, panels, etc. shall be placed in a secure, dry, heated storage building. Maintain the space temperature above 10°C and the space relative humidity below 50%.

.2 Perform a preliminary examination upon delivery to ensure that:

.1 All I&C components supplied for this Contract under this Section of the Specifications comply with the requirements stated in the instrument specification sheets.

.2 All I&C components supplied under other Sections of these Specifications, to be connected to I&C components supplied under this Section of the Specifications, comply with the requirements stated in the Contract Documents.

.3 Itemize all non-conformities noted above and forward them to the Contract Administrator. Any delays in construction resulting from the delivery to Site of non-conforming I&C components shall be borne by the Contractor.

.4 Do not install primary elements or other sensitive equipment until construction is sufficiently completed to provide an "operating condition" environment. Notify the Contract Administrator prior to installing any equipment of this type.

.5 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.

.3 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 at no additional cost to the City. The Contractor shall bear any costs due to construction delays resulting from the delay in delivery of acceptable equipment.

1.3 Site

.1 Classification of Plant Areas

.1 Refer to Division 16.

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 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 Keep one (1) complete, maintained set of Shop Drawings at the Job Site during the construction period. Record modifications and changes as they arise during the construction period and incorporate these changes in the Record Drawings.

.6 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 wiring 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.

.3 Record Drawings

.1 Maintain On-Site a complete set of Record Drawings.

.2 In addition to the requirements stated in Part E, record the following information on the Drawings:

.1 all changes alterations or additions

.2 all instrumentation cable and control tubing

.3 all changes to the numbers and location of outlets, motors, panels and end devices that may occur during the course of the Work.

.3 Before requesting the Certificate of Total Performance, make any necessary final corrections to the Record Drawings, sign each print as a certification of accuracy and deliver all sets to the Contract Administrator for approval.

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.

.2 The design have been based on the use of the first named product where multiple products have been listed.

.3 The instrument manufacturers listed within this Division have been compiled into the list of approved instrument manufacturers that is included in the appendices. Please refer to Division 11 for process specific analyzers not included in this list.

.3 Quality of Products

.1 All products provided to be CSA 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 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.

.6 Use of Products During Construction

.1 Any equipment used for temporary or construction purposes is to be approved by the Contract Administrator. Clean and restore to "as new" condition all equipment prior to the time of Substantial Performance.

2.2 Instrumentation

.1 General

.1 Instruments are to 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 Identify all exposed control conduits at all pull box locations, where the conduits enter or leave a room, and 13 m on centre throughout the room. This shall apply to conduits above removable ceilings. Use Thomas & Betts TY-RAP 5532-M labels for conduit identification.

.7 For direct current wiring use black for positive and white for negative.

.8 For thermistor wiring to motors use red and blue coloured insulated wire.

3. EXECUTION

3.1 Coordination with other Divisions

.1 Examine the Drawings and Specifications of all Divisions and become fully familiar with the Work. Before commencing Work, obtain a ruling from the Contract Administrator on any conflicting issues between Divisions. No compensation will be made for any costs arising from conflict not identified before Work has commenced.

.2 Coordinate the work to be performed under this Section of the Specification with all Divisions installing equipment to ensure that there are no conflicts.

.3 Install anchors, bolts, pipe sleeves, hanger inserts, etc. required in ample time to prevent delays to installation Work.

.4 Lay out 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.

.5 Structural members shall not be cut without prior approval of the Contract Administrator.

.6 Examine previously constructed work and notify the Contract Administrator of any conditions which prejudice the proper completion of this Work.

3.2 Product Handling

.1 Use all means necessary to protect the products included in this division before, during and after installation, and to protect products and installed Work of all other trades.

.2 Any damage to the products and/or installed Work shall be repaired or replaced to the approval of the Contract Administrator by the Contractor.

.3 Remove advertising labels from all products installed that have such labels attached. Identification or CSA labels are not to be removed.

.4 Remove dirt, rubbish, grease, etc. resulting from Work performed under this Division 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 Do not support wiring from pipes, ductwork, etc. Hangers for suspended ceilings may be used for the support of wiring only when approval is obtained from the Contract Administrator and the ceiling installer, and only if approved clips or hangers are used.

.3 Classifications of Circuits

.1 The circuit categorization shall of first priority follow Canadian Electrical Code 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 (>200 A) LV circuits.
	Harmonic-rich LV circuits.
	DC circuits: un-suppressed or above 50 V.
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).

.4 Separation of Circuits

.1 This Section relates to the running of cables carrying differing types of circuit 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' equipment. Verify all control circuits with the Manufacturers of the equipment and make any corrections to the control wiring diagrams that may be required.

.3 Provide power disconnect terminals in marshalling panels for all devices and PLC I/O sourced from the panel.

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.

.2 In removable ceiling areas provide markers on ceiling tile to locate equipment requiring access. Use a 25 mm diameter blue circle painted on the access panel to indicate that it is for instrumentation and control system access.

3.7 Instrument Mounting Stands

.1 Supply and install instrumentation mounting stands as required. Stands are to be either floor or wall mounted. The mounting stands are to be fabricated from aluminium or galvanized steel.

.2 Supply and install protective drip shields for any exterior stand-mounted instrumentation equipment. The drip shield is to extend 50 mm at the top and sides from the front face of the equipment. The drip shield is to be fabricated from aluminium.

3.8 Sealing of Wall and Floor Openings

.1 Seal all conduit and cable entries passing through outside walls of buildings, through partition walls separating electrical rooms from other areas, through fire separations, and through floors above grade.

.2 Seal openings after all wiring entries have been completed.

.3 Sealing material shall be fire resistant and not contain any compounds which will chemically affect the wiring jacket or insulating material. Cable penetrations through fire separations, if required, are to be sealed. Acceptable methods are Canstrut "Fire Stop", Electrovert "Multi-Cable Transit" or Dow Corning RTV Silicone Foam.

3.9 Sleeves

.1 Provide sleeves of galvanized steel pipe with machine cut ends of ample size to accommodate conduits passing through walls, partitions, ceilings, floors, etc.

.2 For wall partitions and ceilings the ends shall be flush with the finish on both sides. For floors, the ends shall extend 100 mm above finished floor level.

.3 Fill the space between the sleeve and the conduit with fire stop material and caulk around the top and bottom with approved permanently resilient, non-flammable and weatherproof silicone base compound. Ensure that the seal is compatible with the floor and ceiling finishes.

.4 Locate the sleeves and position exactly prior to construction of the walls and floors.

.5 Failure to comply with the above requirements shall be remedied at the Contractor's expense.

3.10 Connections to Mechanical, Electrical and Existing Systems

.1 Refer to Division 16 for the required tie-in procedures.

3.11 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 specified, the Contract Administrator will provide naming and numbering that is consistent with the WTP naming conventions.

3.12 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 WTP control and monitoring system.

.5 Where applicable, test all tubing for leaks in compliance with the 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) Business Days of testing.

3.13 Calibration

.1 Instruments are to be factory pre-calibrated. Verify calibration after installation for all instruments installed under these specifications. 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 are 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 0.5% of full range, or to the Manufacturer's stated accuracy of the instrument whenever an accuracy of 0.5% is not achievable.

.5 Perform the following applicable calibration verification for each instrument and its associated signal conditioning equipment:

.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 samples.

.5 Calibrate temperature instruments against a standard lab thermometer.

.6 Online analyzers with known samples.

3.14 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: _____

3.15 Installation and Performance Testing

.1 Refer to the requirements of Division 1 for additional requirements.

.2 Inspections

.1 Provide two (2) weeks written notice to the Contract Administrator prior to energizing any system to allow for inspection by the Contract Administrator of the following:

.1 Proper mounting

.2 Proper connections

.3 During Performance Verification, demonstrate to the Contract Administrator proper calibration and correct operation of instruments and gauges.

.4 Performance Verification of the I&C system is to include but not be limited to the following:

.1 Verify installation of components, wiring connections, and piping connections.

.2 Supervise wiring continuity and pipe leak tests.

.3 Verify instrument calibration and provide written reports.

.4 Function check and adjust the I&C equipment under operational conditions.

.5 Coordinate Manufacturers' service personnel as required for complete system testing.

.6 Instruct plant personnel in correct method of I&C equipment operation.

.7 Direct plant personnel at hand-over as to final adjustment of the system for correct operation of plant.

.8 Ensure that the Manufacturers' Representatives cooperate to complete the Work of this Section.

.9 Verify signal levels and wiring connections to all I&C equipment.

3.16 Training

.1 Provide training, described in detail in Division 1, in the proper operation and maintenance of all control devices, control valves, and ancillary instrumentation described under this Division of the Specifications.

END OF SECTION

SCOPE OF INSTRUMENTATION AND CONTROL WORK

1. GENERAL

.1 Supply and installation all material, equipment, wiring and labour necessary for the installation of the systems detailed on the Drawings in accordance with the Specifications and the latest edition of the Canadian Electrical Code.

2. WORK INCLUDED

2.1 Related Work

.1 Supply and installation of instrumentation and control equipment required to operate the WTP including the plant control system PLC equipment and all Vendor Packages as indicated on the P&IDs.

2.2 General Requirements

.1 Shop Drawings

.2 Record Drawings

.3 O&M Data

2.3 Specific Requirements Included Within but not Limited to the Scope of Work

.1 Supply, Install, test, and verify the performance of all instrumentation, components, materials and ancillary equipment covered under Division 17 of this Contract. A brief description of Work required under this Division is listed here:

.1 Supply, Install, test, and verify the performance of two (2) flange mounted pressure transducers on Surge Tower No.1, to measure the water level in the Tower.

.2 Supply, Install, test, and verify the performance of two (2) high high level float switches, one (1) in each surge tower. The Work involved in the provision of the flaot switch on Surge Tower No.2 shall include the wiring in the existing main control panel to connect the signal to the PLC.

.3 Supply, Install, test, and verify the performance of one (1) valve vault flood level conductivity switch in valve chamber DRV-305.

.4 Supply, Install, test and verify the performance of cabling, wiring and any wiring accessories required to one (1) electrical valve actuator on existing valve FV-YO11A in valve chamber DRV-305.

.5 Supply, install and test all the cabling between the instrumentation and actuators and local junction boxes or main control panels and indicated on the Drawings.

.6 Supply and install all local junction boxes and any other wiring accessories required to complete the Work as described in these specifications and the drawings.

.2 All WTP control system PLC programming and WTP monitoring system HMI software development shall be performed by others.

.3 Coordinate with the individual manufacturers of equipment supplied under other contracts but installed under this Contract to install, test and verify performance of the systems shown on the P&IDs.

2.4 Additional Requirements

.1 Provide all necessary testing, detailed wiring continuity checks, installation integrity checks, equipment functional operation checks, and written system verification reports to provide a complete system.

.2 Provide Performance Verification and start-up of all systems included in the Scope of Work.

2.5 Materials

.1 Cables and bus support systems which are intended to enclose or support all forms of electrical conductors used for any purpose covered by this scope. This includes cable trays, raceways and all forms of rigid, flexible, metallic and non-metallic conduit, and including conduit for communication systems.

.2 Control panels associated with any electrical equipment covered under this Section of Work.

.3 Circuit breakers of all types and for all applications associated with electrical equipment, which receives its power supply from the main, auxiliary or emergency (including UPS) system.

.4 Grounding systems, as required by the Canadian Electrical Code, or as otherwise specified.

END OF SECTION

ENCLOSURES

1. GENERAL

1.1 References - General

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

2. PRODUCTS

2.1 General

.1 Unless otherwise specified, provide outside finishes on all enclosures in ANSI 61 Grey as specified in Division 9.

.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 EEEMAC type 12 gasketted enclosures in MCC rooms and control rooms.

.2 All enclosures for mounting outside of MCC rooms and control rooms to be EEMAC Type 4, watertight except where otherwise specified.

.3 Provide EEMAC 7/3R enclosures for equipment in and around classified areas such as sumps.

.4 Enclosures for certain equipment in corrosive atmospheres to be EEMAC 4X approved for the classification (e.g. chemical cleaning).

.5 Enclosures for mounting field control indicator lamps and switches in unclassified areas to be Allen Bradley model 800T-xTZ die cast enclosures.

.6 Enclosures for mounting field control indicator lamps and switches in Class 1 areas to be Allen Bradley model 800H-xHHX7 cast aluminum enclosures.

2.3 Panel Enclosures

.1 Fabricate panel enclosures from 11 gauge steel panels complete with necessary stiffening to form a rigid free-standing lineup. The structures must be suitable for carrying the weight of the equipment mounted inside the panel and on the doors. Provide removable top and bottom cable entry plates.

.2 Provide panels with front access only. Doors shall be key lockable and fitted with 3-point heavy duty latching assemblies. Provide a continuous piano hinge and a pneumatic hold open device on each door.

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

2.4 Marshaling and Control Panels

.1 Supply, fabricate, checkout, layout, document and deliver to Site fully equipped and functional panels.

.2 Supply all components contained on or within the panels fully wired under this Section of the Specification.

.3 The selection of all accessories, materials, and methods for fabrication not covered by this Specification, but which are necessary to complete the fabrication of the control panels, is the responsibility of the Contractor.

.4 Fans and filters shall be installed to pressurize all control panels thus discouraging dust accumulation and providing air purging for temperature and corrosion control.

.5 Control panel layouts and wiring diagrams are to be provided by the Contractor as Shop Drawings.

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 Install cables in accordance with the requirements of Division 16.

.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 1 PR-TPSH cable connected to it. The cable runs through a junction box to a marshalling panel. The wire identifiers for the pair of wires would be PT-O100A all the way to the marshalling 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 Provide two sources of 120 VAC power 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. Provide a dedicated fused disconnect type terminal block to isolate each individual PLC input and output.

.9 Provide sufficient terminals so that not more than 2 wires are connected under the same terminal. Provide 20% spare terminal capacity at each terminal block assembly.

.10 Terminals shall be Weidmuller W Series color coded as follows:

.1	Red	=	positive 24 VDC
.2	Black	=	analog signal plus
.3	White	=	analog signal common and VAC neutral
.4	Grey	=	120 VAC
.5	Green	=	ground
.6	Yellow	=	shield

.11 Provide nameplates for each device on or within the panels and enclosures. Nameplates shall be white lamacoid with black lettering, a minimum of 25 x 75 mm in size with up to

three lines of 5 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 marshalling panel.

.2 Provide grounding lugs for each panel, suitable for termination of up to #2 AWG copper grounding conductor.

.3 Provide in each marshalling panel an isolated grounding bus bar 6 x 25 x 600 mm, equipped with necessary lugs for accepting two #2 AWG grounding conductors.

.4 Firmly bond all panel mounted devices on or within the panels to ground. Provide supplementary bonding conductors for back panels and doors. Attach a separate bonding conductor to all devices that are not firmly fastened to the panels with screws for such devices as case mounted instruments, meters, etc.

3. EXECUTION

3.1 References - General

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

END OF SECTION

INSTRUMENTATION CABLE

1. GENERAL

1.1 Product Data

.1 Submit product data in accordance with Division 1 and Division 16.

1.2 Related Work

.1 Refer to Division 16.

1.3 Inspection

.1 Provide adequate notice to the Contract Administrator so that all cable installations can be inspected prior to energizing equipment.

1.4 Standards

.1 All wire and cable shall be CSA approved.

2. PRODUCTS

2.1 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 600 V, 90°C.

.3 100% coverage aluminum foil or tape shield.

.4 Separate bare stranded copper drain wire, minimum #18 AWG.

.5 Overall flame retardant PVC jacket to CSA-C22.2.

.6 The entire cable assembly to be suitable for pulling in conduit or laying in cable tray.

.7 Shaw Type 1751-CSA or Belden equivalent.

.2 Where multi-conductor TPSH cables are called for, each pair shall be individually shielded, continuous number coded, and the cable assembly shall have an overall shield and overall flame retardant PVC jacket.

2.2 RTDs and Multi Conductor Shielded Cable

.1 RTD cables shall be CSA approved and shall be constructed as follows:

.1 Three (3) or more copper conductors, stranded, minimum #18 AWG

.2 PVC insulated for 600 V

.3 100% coverage aluminum foil or tape shield

.4 Separate bare stranded copper drain wire

.5 Overall flame retardant PVC jacket to CAS-C22.2

2.3 Teck Cables

.1 As per Division 16

2.4 Wire

.1 As per Division 16

2.5 100 Base TX Category 5E Communication Cable

.1 Category 5E cable shall be CSA approved and constructed as follows:

.1 4 pairs, solid stranded, #24 AWG

.2 PVC inner and outer jackets

.3 UL verified to Category 5E

.4 Insulated for 300 V

2.6 Fibre Optic Cables

.1 Provide break out style fibre optic cable assemblies where indicated in the Specification and Drawings.

.2 Fibre optic cables shall be indoor/outdoor direct burial rated loose tube, rodent protected and constructed with specified quantity of 62.5/125 µm multi-mode glass fibres, spiral interlocked armour, and outer polyethylene jacket. Maximum attenuation shall be 3.5/1.0 dB/km. Minimum modal bandwidth shall be 220 MHz*km

.3 Provide terminations for fibre optic cables including; buffer tube fan out kits, connectors, termination/distribution panels, and wall mount enclosures.

.4 Provide 62.5/125 µm multi-mode duplex fibre patch cords for inter-cabinet connections.

3. EXECUTION

3.1 Analog Signals

.1 Use TPSH cable for all low level analog signals such as 4 to 20 mA, pulse type circuits 24 VDC and under, and other signals of a similar nature.

.2 Use RTD cable for connections between RTDs and transmitters or PLC RTD inputs.

3.2 Digital Signals

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

3.3 Instrument Power

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

3.4 Installation

.1 Install instrumentation cables in conduit systems or in cable trays. Use a minimum of 300 mm and a maximum of 1000 mm length of liquid tight flexible conduit to connect the field sensors to the conduit.

.2 Where non-armoured 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.

.8 Fibre Installation:

.1 Always follow the Manufacturer's guidelines for minimum bend radius and tension. Minimum bend radius shall be a minimum of 20 times the cable diameter.

.2 When installing loose-tube cables, use a silicone injection or sealer to prevent gel migration.

.3 All fibre installations and terminations shall be performed by personnel experienced in fibre optic cable 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 Fibre Terminations:

.1 Ensure that the fibres are not damaged when the buffer tubes and fibre coatings are removed.

.2 After the coating is removed, clean the fibre with isopropyl alcohol to assure the fibre is clean.

.3 Use only high performance connectors as classified and required by TIA-568-A.

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

PROCESS TAPS AND PRIMARY ELEMENTS

1. GENERAL

1.1 References - General

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

2. PRODUCTS

2.1 Process Taps

.1 Supply pressure gauge and thermowell taps. Products shall be as specified in Division 15.

2.2 Primary Elements

.1 Supply and install primary elements and transmitters as specified on the Instrumentation Specification Sheets of Section 17701 – Instrumentation Specification Sheets.

.2 Supply 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 Supply and install drip pots for sensing elements measuring gas. Supply seamless, stainless steel drip pots consisting of a 50 x 300 mm pipe with an isolating valve and a drain valve. Install a separate drip pot on each sensing line. Locate the drain valve within 500 mm of the floor.

.4 Supply diaphragm seals for any fluid other than 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 Supply and install an ethylene glycol filled assembly calibrated by the manufacturer when in-line pressure sensors are specified with a pressure gauge or a pressure switch or in combination.

3. EXECUTION (NOT USED)

END OF SECTION

TRANSMITTERS AND INDICATORS

1. GENERAL

1.1 References - General

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

2. PRODUCTS

2.1 Transmitters and Indicators

.1 Supply and install transmitters and indicators as specified on the Instrument Specification Sheets of Section 17701 – Instrument Specification Sheets.

.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. Provide current-to-current signal isolators for all secondary devices in the control loop.

.3 All transmitters to have local indication scaled in engineering units as specified in the engineering Specifications. Provide a lamicoid 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 loop 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 Pressure Transmitters: Rosemount Model 3051, ABB or Foxboro complete with stainless steel two (2) and three (3) valve manifolds as manufactured by Anderson Greenwood.

3. EXECUTION

3.1 References - General

.1 Refer to Section 17010 – Instrumentation and Controls General Requirements.

END OF SECTION

SWITCHES AND RELAYS

1. GENERAL

1.1 References - General

.1 Refer to Section 17010 – Instrumentation and Controls General Requirements.

2. PRODUCTS

2.1 General

.1 Use normally closed contacts for alarm actuation. The contacts open to initiate the alarm.

.2 Use normally open contacts to control equipment. The contacts close to start the equipment.

.3 Contacts monitored by solid state equipment to be hermetically sealed and adequately rated for the connected load.

.4 Contacts monitored by electro-magnetic devices such as mechanical relays to be rated 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 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 to be 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 relays. Other acceptable Manufacturers are Idec and Potter & Brumfield.

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

.3 24 VDC relays to be Model MY 2PDT plug-in, complete with test button and 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 settings 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 Conductivity Level Switches: Endress & Hauser.

.2 Float Switches: Flygt, Consolidated Electric, Warwick, Magnetrol.

3. EXECUTION

3.1 References – General

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

END OF SECTION

INSTRUMENT SPECIFICATION SHEETS

1. GENERAL

1.1 References - General

.1 The Work includes the provision of all instrument specification sheets.

.2 Refer to Section 17010 – Instrumentation and Control General Requirements for general instrumentation and control requirements related to instrument specification sheets.

1.2 Instrument Specification Sheets

.1 Provide data sheets to itemize detailed as-built information regarding the Specification of instruments included as part of this Work for each instrument supplied. The data sheets already included in this Section list specific minimum requirements for particular applications.

.2 Use forms in accordance with the ISA Standard S20 as a template for the preparation of the specification sheets.

2. PRODUCTS (NOT USED)

3. EXECUTION (NOT USED)

END OF SECTION

INSTRUMENT SPECIFICATION SHEETS

INSTRUMENT SPECIFICATION NUMBER:	I111
DEVICE:	Pressure Transmitter (Gauge and Absolute)
TAG:	PT-Y010A, PT-Y010B
SERVICE:	Measure water level in Surge Tower no.1
PROCESS CONNECTIONS:	4” Flange mounted complete with manifold
RANGE:	TBC
ACCURACY:	±1% of span
OUTPUT:	4 to 20 mADC into 500 ohm
POWER SUPPLY:	Loop powered 24 VDC
CONSTRUCTION:	Stainless steel wetted parts
ELECTRONIC ENCLOSURE:	NEMA 4X
ACCESSORIES:	Stainless steel block and bleed manifold
MANUFACTURER AND MODEL:	Rosemount Model 3051 ABB Foxboro

INSTRUMENT SPECIFICATION SHEETS

INSTRUMENT SPECIFICATION NUMBER:	I125
DEVICE:	Float Switch
TAG:	LS-Y010A LS-Y020A
SERVICE:	High High water level in Surge Towers 1 and 2
OUTPUT:	SPDT Contacts
ENCLOSURE:	Polypropylene float casing with preterminated signal cable
MOUNTING:	Provide strain relief-type connectors to suspend float at desired location. Fabricate mounting brackets from 316 SS. Provide anti-sway rings to prevent sway in turbulent tanks.
MANUFACTURER AND MODEL:	Flygt ENM-10 Consolidated Electric Warwick Magnetrol

INSTRUMENT SPECIFICATION SHEETS

INSTRUMENT SPECIFICATION NUMBER:	I126
DEVICE:	Conductivity Level Switch
TAG:	LS-Y011A
SERVICE:	Valve vault flood in vault DRV-305
RANGE:	4 conductivity measuring ranges selectable via dip switches
OUTPUT:	SPDT Contacts
POWER SUPPLY:	120 VAC, 60 HZ
ENCLOSURE:	PBT Housing; Polypropylene rod insulation
MOUNTING:	Mounted on stainless steel bracket over sump
MANUFACTURER AND MODEL:	Endress & Hauser

END OF SECTION

INSTRUMENT LOOP DRAWINGS

1. GENERAL

1.1 References - General

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

1.2 Instrument Loop Drawings

.1 The following Drawings show typical instrument loop wiring diagrams as referenced by this Specification Section. One (1) Drawing per loop will be fully completed by the Contractor and submitted for approval as Shop Drawings after award of Contract.

WY-A0451
WY-A0452
WY-A0453
WY-A0454
WY-A0455
WY-A0456

.2 The following Drawings of the existing instrumentation and actuator are included for information only.

D-2851
D-2853
D-2863
D-2864

2. PRODUCTS (NOT USED)

3. EXECUTION (NOT USED)

END OF SECTION

INSTRUMENT STANDARD DETAILS

1. GENERAL

1.1 References - General

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

1.2 Instrument Standard Details

.1 The following Drawing provide standard instrumentation installation details as referenced by this Specification Section:

WY-A0457

2. PRODUCTS (NOT USED)

3. EXECUTION (NOT USED)

END OF SECTION